FOURTEENTH ANNUAL REPORT

OF THE

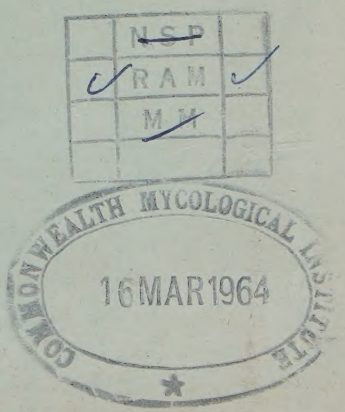
RESEARCH DEPARTMENT

OF THE

COFFEE BOARD

F/51.226

1960-61



Reprinted from the Twenty-first Annual Report of the Coffee Board, 1960–61

FOURTEENTH ANNUAL REPORT

OF THE

RESEARCH DEPARTMENT

OF THE

COFFEE BOARD

1960-61

(1st August 1960 to 31st July 1961)

Price : Rs. 3.00

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THE DIRECTOR OF RESEARCH, COFFEE RESEARCH STATION P.O.
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COFFEE BOARD

RESEARCH DEPARTMENT

THE FOURTEENTH ANNUAL REPORT OF THE RESEARCH DEPARTMENT OF THE COFFEE BOARD — 1960/61

SECTION ONE

1. Administration:

1.1. The report covers the period from 1st August 1960 to 31st July 1961.

1.2. I continued to be in charge of the Research Department throughout the year under report except from 11th October to 12th November 1960 when I was away out of India to attend the first F.A.O. Conference on Coffee Production and Technology at Abidjan in Ivory Coast, West Africa. During this period Sri R. L. Narasimhaswamy, Botanist, was in additional charge of the duties of the Director. The officers named below held charge of the various posts in the Department (other than in the Extension Services) during the year:

1	Sri R. L. Narasimhaswamy	.. Botanist
2	Sri K. V. George	.. Mycologist
3	Dr. P. Somasekhar	.. Entomologist
4	Sri K. C. Ananth	.. Agronomist
5	Sri S. Vishveswara	.. Asst. Botanist
6	Sri H. T. Ranga Setty	.. Special Officer, P.P.T. Scheme (upto 13-5-1961)
7	Sri B. R. Ananth	.. Asst. Chemist
8	Sri K. K. Narayanan Nambiar	.. Asst. Botanist, Leaf Disease Scheme (from 11-11-1960)
9	Sri Lazar Soans	.. Secretary to Director of Research (upto 13-7-1961)
10	Sri C. Ramakrishna Nambiar	.. Superintendent, Coffee Research Sub-Station

1.3. The post of Chemist yet remains to be filled up.

1.4. Sri Lazar Soans, Secretary to Director of Research, was relieved on 12-7-1961, on his transfer to the Marketing Department. Sri N. S. Subramanya Sastry, who was transferred from Marketing Department and posted as Secretary to Director of Research, joined duty on the afternoon of 12-7-1961.

1.5. Sri P. K. Mathew, Asst. Chemist, continued as Asst. Soil Chemist in charge of the Soil Testing Centre at C.R.S. under the expanded Soil Testing Service Scheme of the Government of India. The Centre merged with the Coffee Board, Research De-

partment, from 16-6-1961 after its tenure of three years under the Indian Agricultural Research Institute.

1.6. Sri H. T. Ranga Setty continued to work as Special Officer, P.P.T. Scheme, until 13-5-1961 when he was posted as Jr. Liaison Officer, Chikmagalur.

1.7. Sri K. K. Narayanan Nambiar, who was appointed as Asst. Botanist under the Special Project of Leaf Disease Fungus, joined duty on 11-11-1960.

1.8. Sri B. Swaminathan, who was working as Plant Protection Asst. at Coffee Research Sub-Station, Chethalli, resigned from the post and he was relieved from 10-10-1960.

2. Extension Service:

2.1. I was in charge of the direction and supervision of the Liaison (Advisory) Service and held the direct supervisory charge of the Shevaroys Liaison District.

2.2. The headquarters of the South Kerala Liaison District was shifted to Bodinayakanur in Madras State consequent on the re-distribution of the areas under Pulneys and South Kerala Districts. The South Kerala District consists of Bodinayakanur, Chinnamanur, Munnar and Peermede areas.

2.3. Sri T. V. Pattabhiraman, Sr. Liaison Officer at Coimbatore, retired from service in the afternoon of 26th April 1961 after a distinguished career in the extension service of the Research Department. Sri W. Raghavendra Rao, Sr. Liaison Officer (Devt.), was placed in additional charge of the zone from 27-4-1961.

2.4. Sri H. S. Puttaswamy, Jr. Liaison Officer, Chikmagalur, resigned his post with effect from 7-4-1961.

2.5. Sri K. T. Bhagath, Jr. Liaison Officer, Mudigere, resigned his post with effect from 17-1-1961.

2.6. Sri K. R. Viswanath and Sri N. A. Nanaiya who were appointed as Jr. Liaison Officers reported for duty on 1-3-1961 and 20-4-1961 respectively and they were under training at the C.R.S. and in the private estates till the end of the year.

2.7. Sri A. R. Krishnaswamy, Research Asst. in Botany, and Sri B. R. Venkata Narasimha Iyengar, Research Asst. in Chemistry, and Sri Mehboob Sheriff, Research Asst. in Mycology, were promoted as Offg. Jr. Liaison Officers and posted to Somvarpet, Koppa and Mudigere Liaison Districts respectively.

2.8. The officers named below held charge of the various Liaison Divisions and Districts during the year:

HEADQUARTERS DIVISION

[Dr. N. G. Chokkanna, Director of Research
Sri W. Raghavendra Rao, S.L.O. (Devt.) till 6-6-1961]

Shevaroys District
(Sri C. K. Vasudevan, J.L.O.)

Koppa District
(Sri H. A. Krishnamurthy, Liaison Asst. till 7-6-1961
Sri B. R. V. Iyengar from 7-6-1961)

MADRAS DIVISION

[Sri T. V. Pattabhiraman, S.L.O. till 26-4-1961
Sri W. Raghavendra Rao, S.L.O. (Devt.) till 3-6-1961
Sri K. R. Ahobala Rao, J.L.O., Coonoor, from 3-6-1961]

Nilgiris District
(Sri K. R. Ahobala Rao, J.L.O.)

Pulneys District
(Sri S. J. Mathias, J.L.O. till 17-3-1961 and Sri K. Haridas Menon, J.L.O. from 17-3-1961)

South Kerala District
(Sri P. K. Ramachandran, J.L.O. till 15-2-1961; Sri T. V. Pattabhiraman, S.L.O. till 26-4-1961; Sri W. Raghavendra Rao, S.L.O. (Devt.) till 3-6-1961; Sri K. R. Ahobala Rao, J.L.O. from 3-6-1961)

SOUTH MYSORE DIVISION

[Sri G. I. D'Souza, S.L.O. till 1-9-1960
Sri W. Raghavendra Rao, S.L.O. (Devt.) till 21-11-1960
Sri R. Vijaendraswamy, J.L.O. till 27-3-1961
Sri S. J. Mathias, S.L.O. from 27-3-1961]

N. Coorg District
(Sri G. I. D'Souza, S.L.O. till 1-9-1960; Sri A. R. Krishnaswamy from 19-9-1960)

S. Coorg District
(Sri R. Vijaendraswamy, J.L.O.)

Kalpetta District
(Sri H. Hanumantha Rao, J.L.O.)

Manantoddy District
(Sri M. A. Balasubramaniam, J.L.O. till 20-2-1961
Sri P. K. Ramachandran, J.L.O. from 20-2-1961)

NORTH MYSORE DIVISION

[Sri B. K. Chandrappa, S.L.O.]

Saklespur District
(Sri K. Haridas Menon, J.L.O. till 7-3-1961; Sri M. A. Balasubramaniam from 7-3-1961)

Chikmagalur District
(Sri H. S. Puttaswamy, J.L.O. till 7-4-1961; Sri H. T. Ranga Setty, J.L.O. from 23-5-1961)

Mudigere District
(Sri K. T. Bhagath, J.L.O. till 17-1-1961; Sri Mehboob Sheriff, J.L.O. till 13-6-1961)

2.9. Sri G. I. D'Souza, Sr. Liaison Officer, was granted study leave outside India for 12 months from 1-9-1960.

2.10. Sri W. Raghavendra Rao, Sr. Liaison Officer (Devt.), was relieved on 5-6-1961 on his deputation to Government of Andhra Pradesh, for the development of Coffee Industry in that State.

2.11. Sri L. V. Vaidyanathan, Jr. Liaison Officer, who has been deputed for training in the United Kingdom, under the Colombo Plan during 1959, continued his training during the period under report.

3. Staff Strength:

3.1. The following posts were filled up by promotion/direct recruitment during the year:

1	Asst. Research Officer	1
2	Liaison Officers	5
3	Research/Liaison Assts.	4
4	Ministerial Staff	7
5	Class IV Staff	2

3.2. The sanctioned strength of the Department category-wise and number of personnel working against these posts as on 31st July 1961 are as follows:

Sl. No.	Category	Sanctioned strength	Number working
	CLASS I		
1	Director of Research	1	1
2	Deputy Director of Extension	1	—
	CLASS II		
3	Heads of Technical Sections	5	4
4	Heads of Liaison Divisions	5	4
5	Asst. Research Officers	10	3
6	Jr. Liaison Officers	12	12
7	Farm and Administration	2	2
8	Special Projects	1	1
	CLASS III		
9	Technical	104	83
10	Ministerial	46	40
	CLASS IV		
11	Peons, Attenders, Gestetner Operator, Drivers etc.	49	44
	Total	236	194

3.3. The details of various posts and categories are given in Appendix I. The Board's proposal for the re-organized set up of the Department have been approved by the Government of India. Recruitment of staff for filling up the sanctioned posts has to be taken up by the Board.

3.4. The staff required to man the special project for the study of the different races of leaf disease (*Hemileia vastatrix*) fungus, have been recruited.

3.5. The two special projects one for testing of the proprietary products and the other for the study of the triage problem in coffee (cytological, embryological, morphological and co-ordinated observational studies on Station Selections) continued to function during the year under report.

4. Leave:

4.1. The several technical, administrative and ministerial staff availed Earned Leave for varying periods during the year. The leave availed by Officers of the Department during the year are given below:

Sri R. L. Narasimhaswamy, Botanist	....	1 day
Sri K. V. George, Mycologist	....	63 days
Dr. P. Somasekhar, Entomologist	....	45 „
Sri K. C. Ananth, Agronomist	....	15 „
Sri W. Raghavendra Rao, S.L.O.	....	63 „
Sri Lazar Soans, Secretary to Director of Research	....	60 „
Sri P. K. Mathew, Asst. Soil Chemist	....	36 „
Sri S. Vishveswara, Asst. Botanist	....	14 „
Sri B. R. Ananth, Asst. Chemist	....	26 „
Sri B. K. Chandrappa, S.L.O.	....	13 „
Sri H. S. Puttaswamy, J.L.O.	....	5 „
Sri K. T. Bhagath, J.L.O.	....	32 „
Sri S. J. Mathias, J.L.O.	....	31 „
Sri R. Vijaendraswamy, J.L.O.	....	42 „
Sri K. Haridas Menon, J.L.O.	....	59 „
Sri P. K. Ramachandran, J.L.O.	....	40 „
Sri M. A. Balasubramaniam, J.L.O.	....	66 „
Sri C. K. Vasudevan, J.L.O.	....	54 „
Sri C. R. K. Nambiar, Superintendent, C.R.S.S.	....	48 „

5. Tours:

5.1. I was on tour for 208 days in the year to attend the Meetings of the Board and its Committees and to visit coffee areas in Mysore, Coorg, Wynaad, South Kerala, Nilgiris, Shevaroys and Pulneys. The visits to the coffee areas in the various liaison divisions were mainly for advisory work for assessment of the zonal problems by spot inspections and discussions with the local planters and their Associations, inspection of the working of the various demonstration, re-orientation and exploratory trial plots laid out in the planters' fields, selection of sites for setting up coffee Demonstration Farms and for an assay of the pest and diseases problem. The assay of programmes of the

schemes under the Development Plan was made in a cross-section of each of the areas visited by me. Investigation and assay of the new malady facing the industry formed an invariable part of these tours. I visited over 150 big plantations and an equal number of peasant holdings. The Sub-Station at Chethalli was visited 5 times during the year for inspections and review of the work in progress.

5.2. I was on deputation out of India to attend the first F.A.O. Conference on Coffee Production and Technology at Abidjan in Ivory Coast, West Africa. A detailed report on the tour has been prepared.

5.3. I attended the Advisory Board Council Meeting of A.F.D.C. of Indian Standard Institution held at Delhi during March 1961.

5.4. The Heads of Research Sections undertook tours in the several Liaison Districts in connection with technical advisory work, investigations of zonal problems, inspection of seed blocks of station selections, collection of promising material for breeding work, layout of new experiments and to participate in Scientific Conferences. Number of days each of these officers were on tour during the year is given below:

Sri R. L. Narasimhaswamy, Botanist	....	92 days
Sri K. V. George, Mycologist	....	22 ,,
Dr. P. Somasekhar, Entomologist	....	51 ,,
Sri K. C. Ananth, Agronomist	....	130 ,,

5.5. Sri K. C. Ananth, Agronomist, undertook a survey, extending over a period of 24 days, of the coffee areas in South India to assess the incidence and intensity of the new malady affecting coffee—die-back complex.

5.6. The Asst. Research Officers, the Research Assts. and the Field Staff attached to the several technological divisions were deputed to experimental and problem blocks in the different Liaison Districts for the execution of the programme of work and for collection of data.

6. Construction of Buildings:

6.1. The construction work at the Research Stations continued to be in charge of Mysore Public Works Department. The construction of three twin field staff quarters, two senior staff quarters, labour lines, work-shop and farm stores were nearing completion. The construction work of the Administrative Building has been taken up.

6.2. The construction of Hospital Building at C.R.S. taken up directly by the Research Department, was nearing completion.

6.3. Annual repairs to staff and labour quarters, laboratory, rest house and other general buildings in the Station including the sanitary works were carried out by the Department.

7. Water Supply:

7.1. Out of the two bore wells drilled at C.R.S. one near the pulper was equipped with necessary pumpset. The maintenance of water filters, tanks, wells and the distribution system was attended to as usual.

8. Library:

8.1. The Department continued to be a member of the Indian Association for Special Libraries and Information Centre, Calcutta. During the year, 4 journals were newly subscribed for, and subscription for 2 journals was discontinued. The total number of journals under subscription at the end of the year was 90. In addition to this 14 new journals were received on exchange basis, thus bringing the total number received on exchange basis to 44. Subscriptions were continued for the supply of *Indian Coffee* (English and regional language editions) and *Indian Horticulture* to the Divisional and District Liaison Officers and for the supply of *World Crops*, *Planters Chronicle*, *Tea and Coffee Trade Journal* and *Extension* to the three Divisional Liaison Officers.

8.2 Two hundred and eight books were added to the library during the year of which 23 books were received as gifts. This brings the total number of books in the library to 1,817. Eighty-two books were supplied to the Liaison Officers for equipping their libraries.

8.3. One hundred and sixty-one volumes of journals were got bound, bringing the total to 1,047. Twenty-four books that were damaged by use were also got re-bound.

8.4. A Microfilm camera and Microfilm viewer were received as gift to the Station Library from Mr. Arthur Seidell, 2301, Connecticut Avenue, Washington, U.S.A.

8.5. At the Coffee Research Sub-Station, Chethalli, 16 books were added on to the library thus bringing the total number of books to 251.

8.6. The expenditure for the library for the year works out to Rs. 10,062.49.

9. Meetings:

9.1. I attended 3 meetings of the Board, 4 of the Research Committee, 4 of the Executive Committee, 4 meetings of the Development Committee and 3 of the Quality Committee. I also attended one meeting of A.F.D.C. of Indian Standard Institution Advisory Board, and participated in the Conference and Exhibitions of U.P.A.S.I. I participated and addressed in two meetings of Mysore State Planters' Association and 8 meetings of other Planters' Associations. I also attended a symposium at C.F.T.R.I. and read a paper on 'A Case for Soluble Coffee.' The Annual Staff Conference of the officers of the Research Department, Coffee Board, was held at C.R.S. during April 1961. Sri H. Sitarama Reddy, Chairman, Coffee Board, inaugurated the Conference. The Chairman of the Research Committee, the Board's Development Officer and the Statistical Officer, addressed the officers and participated in the discussions. The Conference discussed and reviewed the progress of work against programme in the Research, Extension and Administrative wings and also the budgetary requirements of each section or division. During the conference two papers, *viz.*, (i) 'Use of Insecticides in Coffee Plantations—Problems, Present and Future', (ii) 'Foliar Nutrition of Coffee' were read by Entomologist and Asst. Chemist, respectively, of the Department.

9.2. Informal discussions with the Heads of Sections, Officers of the Liaison Divisions were held at frequent intervals to evaluate the progress of various studies under investigation.

10. Exhibitions and Conference:

10.1. The Department participated in the exhibitions arranged by the local community as part of the Cattle Shows at Hassan and Mudigere.

11. Correspondence:

11.1. There has been an appreciable increase in the advisory correspondence between the Department and the planting community. The number of advisory letters issued from the two Research Stations and from the Liaison Offices have also increased indicating the awareness of the planters to the day to day problems on coffee culture.

12. Budget:

12.1. The expenditure for the financial year 1960-61 in spite of observance of strict economy in the various Sections of the Department amounted to a sum of Rs. 2,14,919.72 under capital charges and Rs. 8,14,544.48 under recurring charges. In addition to this a sum of Rs. 1,641.05 under capital and Rs. 3,09,541.78 under recurring expenditure inclusive of Rs. 1,45,203.62 towards Loan Aid, was incurred by the Department under the Development Plan, during the financial year.

12.2. The budget provision for the financial year 1961-62 anticipates a programme of expenditure of Rs. 6,66,100.00 under capital works including equipments and Rs. 9,98,400.00 under recurring expenditure inclusive of the maintenance of estates of the two Research Stations and Coffee Demonstration Farms. In addition to the above a sum of Rs. 7,000 under capital charges and Rs. 1,99,600 under recurring charges has been provided for expenditure under schemes V and VI of the department plan during the budget year.

12.3. The expansion of the Research and Liaison services, starting of new projects, provision for construction of administrative office building and residential quarters and acquisition of land for the Coffee Demonstration Farms and provision of equipments for the laboratories etc., account for the increase in budget provision for the year 1961-62.

12.4. The revenue receipts for the year 1961-62 is expected to amount to Rs. 2,25,000 as against an actual receipt of Rs. 2,22,000 during 1960-61 under Research and Extension service. The receipts under the Development Plan are forecast at Rs. 59,000 for 1961-62 financial year against an actual receipt of Rs. 69,656 under Development Plan, during 1960-61.

13. Audit:

13.1. The audit of accounts of the Coffee Research Station, Balehonnur, and Coffee Research Sub-Station, Chethalli, for the year 1959-60 were conducted by the Government Audit Party during January-February 1961 and November 1960 respectively. The Board's Accounts Officer also checked the accounts of the two Stations during December and October 1960.

14. Visitors:

14.1. The Research Stations at Balehonnur and Chethalli and Coffee Demonstration Farms at Saklespur, Gonicoppal, Kalpetta and Pulneys received many planters

and others interested in the planting industry. As already reported the trend of big and small planters visiting the Stations either with the Liaison Officers of their own divisions or of their own accord was on the increase. Groups of progressive farmers of Pandavapura, students of Agricultural Colleges of Dharwar and Hebbal visited C.R.S. during the year.

14.2. The Stations were privileged to receive the following distinguished visitors:

Coffee Research Station:

1. Mr. A. J. Brink of Dow Chemical International.
2. Mr. F. G. W. Jones, Nematologist of the Rothamsted Experimental Station, Herpenden, Herts., United Kingdom.
3. Dr. F. J. Nutman, Leader, Coffee Leaf Disease and Coffee Berry Disease Research Unit, Department of Agriculture, Kenya.
4. Dr. Gilbert Muhr, Soil Testing Adviser to the Government of India.
5. Mr. Alonzo Curtis, Excelso Corporation, Basel, Switzerland.
6. Sri C. I. Machia, Managing Director, Consolidated Coffee Estates (1943) Ltd., and Member, Coffee Board.
7. Sri H. Sitarama Reddy, Chairman, Coffee Board.
8. Messrs V. Kan and Naueg, F.A.O. delegates from Department of Agriculture, Burma.
9. Sri N. P. Datta, Special Officer, Indian Agricultural Research Institute.
10. Sri M. Mallaraj Urs, Director of Agriculture, Mysore State, and Chairman of Research Committee, Coffee Board.
11. Dr. B. T. Narayanan, Director of Research (retd.), of M/s Rallis India Ltd., Bombay.
12. Sri C. B. Sankara Iyer, I.A.S., Development Officer, Coffee Board.
13. Sri K. M. Thomas, Director of Research (retd.).
14. Dr. K. Ramiah, Member of Evaluation Committee.
15. Mr. W. W. Mayne, Member of Evaluation Committee.
16. Dr. M. J. Thirumalachar
    Dr. Aiyappa
    Dr. K. S. Venkata Ramani
    Sri Agnihothrudu
    } Members of "Die-back" Evaluation Committee.

Coffee Research Sub-Station:

17. Sri T. N. Singh, Member, Planning Commission, New Delhi.
18. Sri H. Sitarama Reddy, Chairman, Coffee Board.
19. Members of Goodwill Delegation from West Germany.

Coffee Demonstration Farm:

20. Honourable Sri V. V. Giri, Governor of Kerala.

14.3. The Research Department is indebted to Honourable Sri V. V. Giri, Governor of Kerala, for visiting the Coffee Demonstration Farm at Kalpetta and for inaugurating it.

15. Training in Coffee Culture:

15.1. The scheme for training of nominees from the planting industry and from State Governments launching upon a project of coffee planting was continued.

15.2. The Department imparted training in the various aspects of coffee culture to the following candidates during the year:

1	Sri R. Vaidyanathan	Nominees from the Andaman Administration.
2	Sri P. O. Alexander	
3	Sri M. J. Abraham	
4	Sri V. K. P. Nair	
5	Sri Jacob Kuruvilla	Nominees from Planting Industry.
6	Sri A. P. Achuthan Kutty	
7	Sri Pown Raju	
8	Sri Sanath Kumar	
9	Sri P. C. Padma Prabha	
10	Sri N. A. Naniah	
11	Sri K. A. Cherian	
12	Sri Shiv Shankar	
13	Sri P. V. John	

15.3. In addition, field staff recruited during the year were given a preliminary training in the Farm Section and in the Liaison Districts for a period of 9 months before they were posted to places of their work.

16. Exchange of Seed Material:

16.1. Through the courtesy of Dr. Branquinho d' Oliveira additions were made to the genebank which consisted of *C. arabica Hibrido De Timor* said to be immune to all the eleven races of leaf disease, *134 S.12 Kaffa* and its progeny said to be resistant to all but the X race and *C. racemosa*.

17. Articles Contributed:

17.1. The following articles were contributed by officers and staff of the Department during the period under report:

(a) *Scientific articles:*

1. Ananth, B. R., Iyengar, B. R. V., and Chokkanna, N. G.—'Studies on the seasonal variation of plant foods under different shade trees'—*Ind. Coffee*, 24(8): 347-361 (1960).
2. Vishveswara, S.—'Studies on Morphology and Anatomy of certain Abnormal Growth in Arabica Coffee'—*Ind. Coffee*, 24(8):362-363 (1960).
3. Nagaraj, T. R., and George, K. V.—'A note on Bordeaux toxicity in coffee seedlings'—*Ind. Coffee*, 24(11):452-453 (1960).
4. Achyuta Rao, Y. R.—'Shade tree for coffee: Erythrina lithosperma'—*Ind. Coffee*, 24(12):500-505 (1960).
5. Ananth, K. C., and Chokkanna, N. G.—'A contribution to the knowledge of spore dispersal of *H. vastatrix* by certain species of Thrips occurring in *Coffea Arabica* in South India'—*Ind. Coffee*, 25(1):37-38 (1961).
6. Narasimhaswamy, R. L., and Vishveswara, S.—'Reports on hybrids between some diploid species of Coffea L.'—*Ind. Coffee*, 25(3): (1961).
7. Ananth, K. C.—'A short note on the Phytotoxic effects of BHC on Coffee' —*Ind. Coffee*, 25(6 and 7): 198a-198c (1961).
8. Narasimhaswamy, R. L., Vishveswara, S. Narahari, M., and Achyuta Rao, Y. R.—'Triage in Plantation Coffee in India'—*Ind. Coffee*, 25 (6 and 7):199-204 (1961).
9. Narasimhaswamy, R. L.—'Coffee Leaf Rust in India'—Information Bulletin of Instituto Interamericano De Ciencias Agricolas.
10. Ananth, B. R., and Chokkanna, N. G.—'Zinc deficiency in arabica coffee' (sent for publication to World Crops).
11. Nagaraj, T. R.—'Relations between *Kutilakesopsis macalpinae and nectroid perithecia* occurring on coffee in South India'—Science and Culture—April 1961.
12. George, K. V.—'Diseases of Coffee in South India'—Plant. Chron.—November 1960.
13. Sekhar, P. S.—'Use of Insecticides in Coffee Plantations—Problems, present and future' (sent for publication in *Ind. Coffee*).

(b) *Popular articles:*

1. Chokkanna, N. G.—'Progress of Coffee Research in India'—Plant. Chron. UPASI Conf. Suppl., 1960, pp. 29-31.

17.2. Abstracts of literature, practical hints to planters inclusive of timely plant protection warning notes for each month, answers to questions received from planters on the different aspects of coffee culture, continued to be published in the Board's monthly bulletin *Indian Coffee* as a regular feature.

18. Soil Testing Laboratory:

18.1. The Soil Testing Centre completed its tenure of three years under the Indian Agricultural Research Institute, New Delhi, on 15-6-1961. The Centre has since been taken over by the Coffee Board.

18.2. The following is the resume of work carried out from 16th June 1958 to 31st July 1961.

18.2.1. The main objective of the Soil Testing Programme, in general, is to test soils and advise farmers on the type and quantity of fertilisers to be applied to ensure increased production. The Soil Testing Centre at the Coffee Research Station, is primarily meant for the benefit of the coffee planters.

18.2.2. The samples are analysed for available nitrogen, available phosphorus, available potassium, pH and total soluble salts. The cropping history of the plant is studied against the background of the cultural practices in vogue, the plant foods received and the level of available nutrients in the soil. Suitable fertiliser recommendations are then prescribed.

19. Progress of Work:

(A) Advisory:

19.1. (a) *Laboratory:* The Centre handled 14,927 soil samples during the period. Of these, 6,559 samples were collected by the staff of the Centre. The remaining 8,370 samples were received either from the Liaison Officers of the Department or from the planters direct. 11,438 samples were for advisory purposes the rest being from the experimental plots to study the initial nutrient status for crop correlation studies.

19.1.1. The Centre analysed all the 14,927 samples received at the laboratory. Based on the analytical results of samples from the various Districts, the soils may be rated with respect to each nutrient as follows:

Classification	*Constituents*			
	Available nitrogen	Available phosphorus	Available potassium	pH
Low	23%	91%	12%	
Medium	68%	7%	44%	
High	9%	2%	44%	
Acidic	—	—	—	76%
Normal	—	—	—	24%

19.1.2. It is seen from the above figures that 91% of the soil samples analysed are deficient in available phosphorus indicating that these soils are apt to respond to application of phosphoric acid in suitable form. Only 12% of the soils are low in available potassium the rest being either medium or high in this constituent. 77% of the samples are either medium or high in available nitrogen. The pH values show that 76% of the soils are acidic in reaction indicating the need for liming.

19.1.3. A comparative study of the nutrient status of the soils and the average yield obtained from the different regions reveals that the highest yield, in general, is obtained from areas of normal pH, *i.e.*, 6.0 to 7.5, medium nitrogen, medium to high phosphorus and medium potassium. Attempt to bring out the same level of nutrients in areas of poor yield by judicious manuring will go a long way in helping increased crop production. A map showing the deficiency spots in each Liaison District is under preparation.

19.1.4. Manurial recommendations relating to all the 11,438 samples were sent during the period. The recommendations were either for a re-orientation of the existing schedule of manuring or for alteration in the dosage of certain plant foods to adjust to the level of nutrients present in the soil.

19.2. (b) *Follow-up work:* In a programme of the type of service rendered, it is essential to assess the value of the recommendations made by a follow-up work. The follow-up work will bring to light the type of modifications, that may be necessary in the existing basis of recommendation. Attempt was made initially to find out to what extent the recommendations were followed by the planters. It was encouraging to find that the small growers invariably adopted the recommendations with the same enthusiasm as was evinced for getting their soils tested. Majority of the medium size holdings and quite a few of the big planters welcomed the recommendations with modifications in certain cases to adjust to their other financial commitments.

19.2.1. As regards the usefulness of the recommendations made, an assessment in terms of economy level is possible only when the actual crop figures are on hand. Enough yield data will be available only from 1961-62 season onwards. The data obtained from an estate in Mallandur area which revised the manuring schedule according to the recommendations sent out from this Centre show that there has been remarkable improvement both in the growth of the bush as well as in the crop harvested. The increase in crop was 13% during the first year and 40% during the following year as seen from the figures given below:—

Year	Crop picked (bushels)	Increase in crop	% increase
1959	4,560	—	—
1960	5,160	600	13
1961	6,400	1,840	40

(B) Research:

19.3. Quite a lot of research work is necessary to standardise methods of collection of soil samples, depth of sampling, the distance of sampling spot in relation to the plant position, the manuring practice, the extent of root system and the like. The test result to be of value is to be studied against the extent of correlation it gives with yield and fertiliser application. Other investigations which become necessary in the light of the soil test results also will have to be taken. Some studies have already been started. They are indicated below.

19.3.1. (i) *Soil Test-Crop Correlation Studies:* Recommendations based on soil test results have always to be guided by soil test-crop correlation studies. Though these

results are available for annuals and which to some extent can be followed as a guide in the case of perennials like coffee, actual data in this line are needed to make more precise fertiliser recommendations. With this idea in view, the initial nutrient status of soils from the differential experimental plots in the two research stations has been determined. The basic crop figures have also been collected. Soils from these plots are being collected every quarter to assess the level of available nutrients during the different phases of the development of coffee berry. Similar studies are planned in the different coffee growing zones to enable to prescribe more accurate fertiliser recommendations suited to each area.

19.3.2. (ii) *Studies on the correct sampling spot in relation to the plant position:* It was noted in the course of analysis of soil samples for advisory work, that soil samples collected from patchy spots or from young plantations were very low in available nutrients, in spite of fairly heavy manuring of the fields. In samples collected in an identical manner from fields of well-covered coffee, the variation in nutrients between well-manured and ill-manured plots was perceptible. Soil samples from coffee fields are collected for analysis from the middle of four plants. This position coincides with the drip circle of plants where coffee has spread in. Fertilisers are applied in the drip circle of plants where the feeding roots are concentrated most. When samples are collected in the same manner from fields where the bushes have yet to close in, the sampling spot happens to be away from the root zone and also away from the region of application of manures. Several samples from near the drip circle and from the centre of four plants were collected from experimental plots receiving varying levels of plant nutrients. The level of available nutrients in these soils was determined. It was found that the samples from the centre of four plants continued to show practically the same values when tested either prior to or after application of fertilisers in the control as well as in the treated plots. The samples from near the drip circle showed considerable variation in nutrient status. This indicates that samples have to be taken near the drip circle where changes in nutrient level take place due to application of fertilisers and absorption by the root system. More sets of samples are being examined to study the nature of variation of nutrients at the root zone.

19.3.3. (iii) *Studies on the availability of phosphoric acid in coffee soils:* As revealed from the analytical results of samples 91% samples are low in available phosphorus. This can well be one of the limiting factors in crop production. Studies are being conducted to make available sufficient phosphoric acid in the soil. The present line of study is based on the principle of satisfying the fixing capacity of soils by addition of superphosphate and then trying to maintain the level of available phosphoric acid in the soil. Preliminary exploratory trials with soils from three different areas are in progress.

20. Visits by Committees:

20.1. The Coffee Board at its meeting held in December 1959 resolved that a Committee consisting of Sri W. W. Mayne, Sri K. Ramiah and the Director of Research may evaluate the work done in the Research Department since the publication of the Ramanathan-Bal Committee report.

20.2. The Committee visited the Coffee Research Station and Coffee Research

Sub-Station during December and reviewed the work that is being carried out by the Department. The report of the Committee is awaited.

20.3. The Research Committee of the Coffee Board at its meeting held in August 1960 had recommended the setting up of a special project for investigating the causes of the new malady affecting coffee and making such recommendations as might be necessary for its control and eradication. Accepting the recommendations of the Research Committee the Board set up an ad hoc Committee of experts to advise it on the set up of the proposed project. It consisted of Dr. B. T. Narayanan, Director of Research (retd.) and now with M/s. Rallis, Dr. M. J. Thirumalachar of M/s. Hindustan Antibiotics, Pimpri, Dr. K. S. Venkataramani, Botanist of U.P.A.S.I., Shri Agnihothrudu of Tocklai Tea Experimental Station, Dr. Aiyappa (a nominee of the I.C.A.R.), and Director of Research.

20.4. The Committee visited both the research stations during September-October, held discussions with the Director of Research and subject matter specialists, visited the problem estates in Mysore State, examined specimens of affected plant parts and tissues and reviewed their findings.

21. Acknowledgments:

21.1. It is my privilege and pleasant duty to express my deep sense of gratitude to the many planters who have so generously co-operated in the layout of various field trials and demonstration plots and given unstinted help in so generous a measure.

21.2. I am deeply grateful to the Director and members of staff of Central Food Technological Research Institute, Mysore, for very generously assisting us in the maintenance and repairs of many of our precision instruments and for the courtesy and help extended to us in analysing various samples.

21.3. To the various proprietary firms and distributors especially to M/s. Rallis India (Private) Ltd., Parry & Co., Scientific Fertiliser Co., Mysore Fertiliser Co., and Indian Potash Scheme who extended their co-operation by donating fertilisers for the conduct of field trials, I am beholden.

21.4. To many scientists and research workers in India and abroad who exchanged publication and materials, especially in the investigation of new malady affecting coffee, I am deeply grateful.

21.5. The Department and I are deeply grateful to the Director and members of the staff of the Commonwealth Institute of Entomology, London, who were generous in identifying the insect specimens sent from the Department from time to time.

21.6. The valuable information and help provided by Mr. F. G. W. Jones, Nematologist, Dr. Mary T. Franklin, Rothamsted Experimental Station, United Kingdom, Dr. A. M. Golden, Dr. A. L. Taylor, Nematology Investigations, U.S.D.A., Dr. W. H. Anderson, Chief, Insect Identification and Parasite Introduction Research Branch, U.S.D.A., and Dr. M. R. Siddique, Department of Zoology, Aligarh Muslim University, Aligarh, Uttar Pradesh, are acknowledged with grateful thanks.

21.7. The Department and I owe a debt of gratitude to the Members of the Evaluation Committee and the Die-back Survey Committee for their kind indulgence, valuable suggestions and timely guidance in our work.

21.8. The Department is indebted to Mr. Arthur Seidell of Washington, U.S.A., for the generous gift of a microfilm camera and viewer to the Station Library.

21.9. My colleagues and I record with gratitude the kindness, consideration and valuable suggestions we have received from all Members of the Board, in particular from the Chairman, Coffee Board, and Chairman, Research Committee.

21.10. To all sectors of the Industry, the Planters Associations, the wide circle of planter friends in the various coffee Districts, sister technical institutions and the several State Departments of Agriculture, my colleagues and I express our deep sense of gratitude for the courtesy and consideration extended to us generously in our contacts with them. To the sister Departments of the Board, I am indebted for ready assistance and ready co-operation.

21.11. Special mention with gratitude is made of the excellent arrangements made by the planters in Kalpetta, in particular by Sri M. K. Jinachandran, M.P. and Sri Dharmaraja Iyer, in connection with the inauguration ceremony of Coffee Demonstration Farm at Kalpetta.

21.12. To the various grades of technical, executive and ministerial service at the two Research Stations and the Liaison Divisions and Districts, I cannot be sufficiently grateful. They have borne cheerfully the brunt of the burden by their ever willing co-operation and unstinted hard work.

21.13. Brief reviews of work done in the Estate and in the different Research and Extension Divisions together with the detailed Section Reports are presented in the following pages.

N. G. CHOKKANNA,
Director of Research

COFFEE BOARD, RESEARCH DEPARTMENT

APPENDIX I

Statement Showing the Staff of the Research Department as on 31st July 1961 (Including Posts under Research Reorganization Scheme and Soil Testing Centre, Coffee Research Station)

Sl. No.	Designation	Distribution of Staff				Total
		H.Q. Stn. C.R.S.	Sub-Stn. Chethalli	Extension Service	Develop-ment Plan	
	Class I—					
1	Director of Research	1	—	—	—	1
2	Dy.Director of Extension	—	—	1	—	1
	Class II—					
3	Chemist	1 (vacant)	—	—	—	1
4	Botanist	1	—	—	—	1
5	Agronomist	1	—	—	—	1
6	Mycologist	1	—	—	—	1
7	Entomologist	1	—	—	—	1
8	Sr. Liaison Officers	—	—	4 (1 vacant)	1	5
9	Superintendent	—	1	—	—	1
10	Asst. Chemist	2 (1 vacant)	—	—	—	2
11	Asst. Botanist	2 („)	—	—	—	2
12	Asst. Mycologist	1 („)	—	—	—	1
13	Asst. Entomologist	1 („)	—	—	—	1
14	Asst. Agronomist	1 („)	—	—	—	1
15	Asst. Plant Physiologist	1 („)	—	—	—	1
16	Jr. Liaison Officers	—	—	12	—	12
17	Secretary to Director of Research	1	—	—	—	1
	Class III—					
18	Head Clerks	3	1	—	—	4
19	Senior Clerks	4	1	—	—	5
20	Junior Clerks	6	2	11 (4 vacant)	11 (2 vacant)	30
21	Stenographer	1	—	—	—	1
22	Camp Clerk	1	—	—	—	1
23	Typists	1	1	—	—	2
24	Store Keeper	1	—	—	—	1
25	Research Assistants	7 (2 vacant)	2	—	4	13
26	Liaison Assistants	—	—	—	7 (2 vacant)	7
27	Statistical Assistant	—	—	—	1	1
28	Farm Assistant	1	—	—	—	1
29	Jr. Scientific Assistant	1	—	—	—	1

APPENDIX I (Contd.)

Sl. No.	Designation	Distribution of Staff				Total
		H.Q Stn. C.R.S.	Sub-Stn. Chethalli	Extension Service	Develop-ment Plan	
30	Field Assistants (Jr.)	11	5	39 (8 vacant)	14 (2 vacant)	69
31	Foreman Mechanic	1	—	—	—	1
32	Fitter	1	—	—	—	1
33	Compounder	1	—	—	—	1
34	Asst. Mechanic	1 (vacant)	—	—	—	1
35	Artist-cum-Photographer	1 („)	—	—	—	1
36	Computor	1 („)	—	—	—	1
	Class IV—					
37	Drivers	2	1	3	1	7
38	T. B. Attenders	2	1	—	—	3
39	Mechanical Attenders	1	1	—	—	2
40	Laboratory Attenders	6	1	—	—	7
41	Peons (including Gestetner Operator)	10 (5 vacant)	1	15	1	27
	Scheme for Testing Proprietary Products:					
	Class II—					
42	Special Officer	1 (vacant)	—	—	—	1
	Class III—					
43	Assistants	3 (2 vacant)	—	—	—	3
	Project for Leaf Disease Fungus:					
	Class II—					
44	Assistant Botanist	1	—	—	—	1
	Class III—					
45	Junior Assistant	1	—	—	—	1
	Soil Testing Centre:					
	Class II—					
46	Assistant Soil Chemist	1	—	—	—	1
	Class III—					
47	Junior Scientific Assistants	3 (1 vacant)	—	—	—	3
48	Junior Clerk	1	—	—	—	1
49	Driver	1	—	—	—	1
	Class IV—					
50	Laboratory Keepers	2	—	—	—	2
	Total	93	18	85	40	236

SECTION TWO

1. Report on the Working of the Estate at the Coffee Research Station, Balehonnur, and Coffee Research Sub-Station, Chethalli:

1.1. There were no changes in the staff of the Farm Sections and Sriyuths T. H. Thimme Gowda and C. Ramakrishnan Nambiar continued as Farm Assistant and Superintendent at the Coffee Research Station, Balehonnur, and Coffee Research Sub-Station, Chethalli, respectively. Shri S. J. Mathias, Sr. Liaison Officer, Marcara, was in charge of the current duties of the Superintendent, C.R.S.S., Chethalli, when the latter was on earned leave. The other technical and ministerial staff attached to these sections were on leave for short periods during the year.

2. Season and Climate:

2.1. The Coffee Research Station, Balehonnur, received a total rainfall of 162.28 inches (4121.9 mm) on 136 rainy days as against 111.92 inches (2842.9 mm on 155 rainy days for the corresponding period in the previous year and against 115.56 inches (2935.1 mm) and 116.70 inches (2964.3 mm) being the averages for the past 10 and 34 years periods respectively. The rainfall during the year under report was thus 50.36 inches (1279 mm) in excess of the previous year and 9.80 inches (248.8 mm) over the decennial average.

2.2. The South-West Monsoon of 1960 set in by the second fortnight of May continued somewhat intermittently during June and was active in July. However, there was a break for about a week in the first fortnight in July. The monsoon continued to be active during August. July received a precipitation of 41.04 inches (1042.4 mm). After a late start in the last week of October the North-East Monsoon tailed off during last week of November, with erratic trends giving a total of 15.67 inches (398.0 mm). After the cessation of the monsoon a dry period of 118 days was experienced. The blossom showers for the year 1961 were received during last week of March (23-3-1961—0.47 inches, 30-3-1961—0.37 inches). The response to this 0.84 inches of blossom showers in general was quite satisfactory. Backing showers were received during first week of April and this helped in the revival of bushes after the dry period and in the production of new wood and flush. The monsoon for the year 1961 set in during the second fortnight of May continued to be unusually active during June and July. The precipitation in July was 71.73 inches (1819.4 mm) as against 41.03 inches (1042.4 mm) received during the same period of last year.

2.3. At the Sub-Station, Chethalli, a total rainfall of 116.57 inches (2961 mm) was received on 169 rainy days as against 70.24 inches (1784 mm) on 115 rainy days recorded for the corresponding period of the previous year. The first blossom showers of 0.45 inches was received as early as 17th February and nearly 5 to 10% of the spikes moved. Subsequently during last week of March a total of 0.91 inches of rain was received distributed over 3 days and this helped in opening nearly 80% of the spikes in selection plots of the Station. The spikes on the old coffee bushes and the remaining selection plants opened during the 1st week of April. Sufficient if not heavy backing showers

were received. The blossom on the whole was very erratic. Setting on the whole was not quite satisfactory as compared to last year.

3. Incidences of Diseases and Pests:

3.1. At Coffee Research Station, an early incidence of leaf disease during the year 1960 was experienced causing considerable defoliation, followed by Die-back of tertiary branches. The break in the South-West Monsoon rains experienced during the first fortnight of July 1960 gave impetus to the spread of the disease. During the following months of September, October, November and first half of December fresh activity of the pathogen and disease spread continued. The fairly good crop carried on the bushes added further to the strain on the already weakened bushes. From December onwards, fresh incidences were rare, but defoliation of earlier affected leaves followed by Die-back of tertiary branches continued till end of February 1961.

3.2. With the receipt of early blossom showers during last week of March and the well distributed intermittent rains during the summer months, new flush formation was noticed to be satisfactory, the bushes recovering considerably. The prevailing weather conditions being favourable to the disease, renewed activity of the pathogen was noticed and resulted in some fresh disease incidences. Fortunately the heavy continuous rains coupled with strong wind and cloudy weather conditions experienced since mid June and throughout July, temporarily arrested continued spread of the disease so far. However, it is anticipated that with the slackening of South-West Monsoon, serious outbreaks of leaf disease may be encountered.

3.3. During 1960 season incidence of 'Kondli' disease was negligible. This year also so far there are no indications of the disease. Incidences of 'Damping off'. 'Brown-eye-spot' were also not serious during the current season. Consequent to the continued long spell of cloudy weather and heavy rains providing saturated atmospheric conditions, incidence of 'Black rot' was noticed to be comparatively more wide-spread. A mild incidence of 'Die-back complex' occurring during the months of April and May was mostly covered with new growth and recovery was observed. The continuous wet weather conditions during June-July had caused defoliation and crop shanking to a small extent.

3.4. Parasitic Eel-worms were detected in M block, Crawford area, N.M.S. I and pH cisterns. The incidence of Shot hole borer was comparatively higher during 1960-61. The peak incidence was reached in October 1960. Red borer incidence in 5 selected blocks under study—N.M.S. IV, V, L2 Seed block, 1955 Seed block and J. Blocks—remained higher than that of the rest of the estate. Peak incidence was reached in April 1961. The incidence in the general estate is low. The incidence of White stem borer was as low as one plant per acre.

3.5. At the Coffee Research Sub-Station, Chethalli, incidence of leaf disease was very mild during the year. Carry over of healthy leaves was appreciable throughout the year. Regular tracing of borer revealed that incidence was very low. The incidence of Green bug and other pests in coffee was much below pest level. Die-back was noticed on stray bushes and the plants had recovered completely after the receipt of showers.

4. Area—Replanting and New Clearing:

4.1. The area under coffee in the two Stations are:—

	Planted area (in acres)		Bearing area (in acres)	
	Arabica	Robusta	Arabica	Robusta
Balehonnur	117.74	31.76	95.74	29.00
Chethalli	112.31	10.04	111.01	10.04

4.2. An area of five acres of jungle which was cleared at Coffee Research Station during last year, were planted with S. 795 Arabica material during this year under intensive cultivation programme. At Coffee Research Sub-Station a small area of 0.25 acres was cleared to plant exotic varieties of coffee and an area of 0.66 acres was replanted with Station Selections under Brazilian method of cultivation.

5. Crop:

5.1. The yield of uncured coffee harvested during the year is as follows:

	YIELD OF COFFEE IN LITRES				
	Balehonnur			Chethalli	
	Arabica	Robusta	Tree coffee	Arabica	Robusta
A. Parchment	38,986.18	29,603.31	—	67,493.6	—
B. Cherry	46,514.29	13,092.37	7,073.51	1,22,414.7	12,110.5
C. Gleanings and Bits	6,964.41	5,455.16	—	16,557.4	—
D. Others including Seed Coffee	5,485.88	1,158.77	25.08	1,709.3	—
Total	97,950.76	49,309.61	7,098.59	2,08,175.0	12,110.5
Yield of Clean Coffee in M. Tonnes	24.35	15.57	1.26	51.5	2.75

5.2. A crop of 24.35 M. tonnes of Arabica, 15.57 M. tonnes of Robusta and 1.26 M. tonnes of Tree coffee aggregating to 41.18 M. tonnes was harvested during 1960-61 season, as against an estimate of 18.28 M. tonnes of Arabica, 10.16 M. tonnes of Robusta and 762.036 kg. of Tree coffee, aggregating to 29.20 M. tonnes at Coffee Research Station, Balehonnur. The crop for 1961-62 is estimated at 25.4 M. tonnes of Arabica and 10.16 M. tonnes of Robusta and 0.50 M. tonne of Tree coffee.

5.3. At the Coffee Research Sub-Station, Chethalli, a crop of 51.5 tonnes of Arabica and 2.75 tonnes of Robusta was harvested during 1960-61 season as against an estimate of 31 tonnes of Arabica and 1.5 tonnes of Robusta. The crop for 1961-62 is estimated at 45.5 tonnes including Robusta.

6. Seed Distribution:

6.1. In addition to the seed blocks at both the Stations, the zonal seed plots located in private estates, continued to meet the increasing demand of the major Station Selections. Seven estates in Mysore zone and one in the Nilgiris continued to work as regional seed plots. Seed coffee was prepared under the strict supervision of the Research Department. The quantity of seed collected from these blocks as well as from the two Research Stations is given below:

	Source	Arabica (in kg.)	Robusta (in kg.)	Tree coffee (in kg.)
1	Coffee Research Station, Balehonnur	491.22	404.5	10.44
2	Coffee Research Sub-Station, Chethalli	681.68	—	—
3	Zonal Seed Blocks	3,572.00	—	—
	Total	4,744.90	404.5	10.44

6.2. A total quantity of 4736 kg. of Arabica, 313 kg. of Robusta and Tree coffee were distributed to 2142 planters during the year 1960-61 as against 5191 kg. of Arabica, 246 kg. of Robusta and Tree coffee seeds distributed to 2512 planters in the previous year.

7. Paddy and Other Crops:

7.1. In the wet land paddy was grown in an area of 2.50 acres at Coffee Research Station, Balehonnur, and 6.00 acres at C.R.S.S., Chethalli. Two crops were taken during this year at C.R.S. A comparative statement of the yield obtained at these two Stations are given below:

	Station	Area in acres	Yield of grain in kg.		Yield of straw in kg.	
			1959-60	1960-61	1959-60	1960-61
1	Coffee Research Station, Balehonnur					
	a) Monsoon paddy	2.50	2,072.96	2,253.44	2,655.90	3,401.95
	b) Summer paddy	2.50	2,337.19	973.86	1,770.60	680.39
2	Coffee Research Sub-Station, Chethalli	6.00	5,815.70	3,840.80	3,541.20	1,784.40

7.2. The prospects of the orange crop was good during the year when compared to last year. A sum of Rs. 8,251.00 was realised in 1960-61 season as against Rs. 815.00 obtained during the previous year. The crop prospects for the coming year is not very good since the blossom and setting was very poor.

8. Miscellaneous:

8.1. Both the Stations continued to be members of the United Planters Association of Southern India and the regional Planters' Associations. The Sub-Station continued to be a member of the Coorg Orange Growers' Co-operative Society.

8.2. The labour strength at Coffee Research Station which was 125 at the end of last year closed with 141 at the end of the year against a sanctioned strength of 170. The average labour out-turn was 75% during the year as against 73% last year. The labour strength at Coffee Research Sub-Station, Chethalli, was 98 as against the sanctioned strength of 130. The employer-employee relationship continued to be cordial and happy at both the Stations. Independence Day and the Republic Day were celebrated at both the Stations in a befitting manner. Mazdoors were granted holidays with wages on these days and entertained to sports and refreshments.

8.3. The Canteen intended for the benefit of the mazdoors continued to cater during this period at Coffee Research Station, Balehonnur. The Creche for the children at Chethalli continued to be maintained. Milk for babies and mid-day meals for non-working children were provided. Children's Parks which were formed at both the Stations during last year continued to be maintained. A Radio was working at Coffee Research Sub-Station, Chethalli, while two Radios were working at Coffee Research Station, one in children's park and another for the benefit of the mazdoors.

N. G. CHOKKANNA,
Director of Research

APPENDIX M—I

Meteorological Data of the Coffee Research Station, Balehonnur—1960-61

Sl. No.	Description		Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July
1	Highest Maximum Temperature	F	79.5	81.5	83.5	80.5	83.1	84.1	91.5	94.5	93.5	90.0	82.2	73.0
		C	26.4	27.2	28.6	26.9	28.4	28.9	33.1	34.7	34.2	32.2	27.9	22.8
2	Lowest Maximum Temperature	F	68.5	68.9	74.5	71.5	76.5	74.5	79.5	87.0	84.3	72.3	69.1	68.5
		C	20.3	20.5	23.6	21.9	24.7	23.6	26.4	30.6	29.1	22.4	20.6	20.3
3	Highest Minimum Temperature	F	66.5	67.0	67.2	65.6	63.5	64.5	63.6	68.0	69.5	68.6	68.2	66.1
		C	19.2	19.4	19.6	18.7	17.5	18.1	17.6	20.0	20.8	20.3	20.1	18.9
4	Lowest Minimum Temperature	F	63.0	62.5	57.5	55.0	50.5	55.0	54.0	62.0	62.0	61.5	62.6	61.7
		C	17.2	16.9	14.2	12.8	10.3	12.8	12.2	16.7	16.7	16.4	17.0	16.5
5	Average Maximum Temperature	F	72.5	75.5	78.8	76.9	81.0	81.2	85.2	90.9	88.9	82.2	76.9	71.2
		C	22.5	24.2	26.0	24.9	27.1	27.3	29.6	32.7	31.6	27.9	24.9	21.8
6	Average Minimum Temperature	F	65.5	65.0	63.0	62.5	57.7	59.0	59.8	64.0	66.5	66.2	65.3	64.7
		C	18.6	18.3	17.2	16.9	14.3	15.0	15.4	17.8	19.2	19.0	18.5	18.2
7	Highest Humidity	%	97	97	97	97	97	97	97	97	97	97	97	97
8	Lowest Humidity	%	82	88	85	81	66	48	48	40	69	81	82	95
9	Average Humidity	%	94	95	93	92	81	82	81	84	93	94	95	97
10	Highest number of hours of bright sunshine ..		4-36	10-00	10-00	10-00	9-30	*	10-30	10-30	11-30	11-30	9-30	0-30
11	Lowest number of hours of bright sunshine ..		—	—	0-12	—	5-30	*	7-00	6-12	3-30	—	—	0-12
12	Average number of hours of bright sunshine		2-06	2-29	6-45	5-23	8-12	*	9-12	9-22	8-21	6-09	3-48	0-03
13	Number of days on which rainfall was below 10 cents		6	3	3	5	—	—	—	—	1	5	6	—
14	Number of days on which rainfall was between 10-50 cents		10	15	3	4	—	—	—	2	7	4	10	3
15	Number of days on which rainfall was between 50-100 cents		7	3	2	2	—	—	—	—	3	1	3	5
16	Number of days on which rainfall was between 1″ and 2″		2	1	3	3	—	—	—	—	1	7	5	9
17	Number of days on which rainfall was above 2″		3	1	1	—	—	—	—	—	—	1	3	14
18	Total number of rainy days during the month		22	20	9	9	—	—	—	2	11	13	21	31
19	Total rainfall during the month—Inches		19.83	9.30	11.46	6 73	—	—	—	0.84	5.08	14.49	22.22	71.72
	Millimetres		503.6	251.8	291.1	171.1	—	—	—	21.3	129.0	368.1	564.6	1821.9
20	Highest rainfall during the month—Inches		3.39	2 61	4.40	1.40	—	—	—	0.47	1.12	4.36	4.61	6.18
	Millimetres		86.1	66.3	111.8	35.6	—	—	—	11.9	28.5	110.7	117.1	157.0

* Data not recorded due to non-availability of Sun-shine Recorder Cards.

APPENDIX M—II

Rainfall Data of the Coffee Research Station, Balehonnur—1960-61 (Rainfall recorded in inches and millimetres)

Sl. No.	Month		1950-51	1951-52	1952-53	1953-54	1954-55	1955-56	1956-57	1957-58	1958-59	1959-60	Average of 10 years	1960-61
1	August	Inches	20.11	19.40	28.28	30.70	27.90	15.32	19.96	23.14	23.44	21.10	22.93	19.83
		Millimetres	510.8	492.8	718.3	779.8	708.7	389.1	507.9	587.7	595.3	535.6	582.44	503.6
2	September	Inches	21.12	9.77	3.72	6.07	7.69	13.76	6.26	2.44	6.61	13.70	9.11	9.90
		Millimetres	536.5	248.2	94.5	154.2	195.3	349.5	159.0	61.9	168.0	348.1	231.4	251.8
3	October	Inches	6.43	6.74	13.07	20.22	6.41	8.37	12.46	17.30	5.42	5.44	10.19	11.46
		Millimetres	163.3	171.2	332.0	513.6	162.8	212.6	316.5	439.5	137.5	138.3	258.8	291.1
4	November	Inches	1.27	3.12	—	—	—	0.60	4.13	7.27	1.22	0.78	2.63	6.73
		Millimetres	32.3	79.3	—	—	—	15.2	104.9	184.6	30.9	19.8	66.7	171.1
5	December	Inches	—	—	1.42	—	0.77	—	—	0.05	—	0.39	0.66	—
		Millimetres	—	—	36.1	—	19.6	—	—	1.3	—	10.0	16.8	—
6	January	Inches	—	0.12	—	—	—	—	—	0.04	—	—	0.09	—
		Millimetres	—	3.6	—	—	—	—	—	1.0	—	—	2.3	—
7	February	Inches	—	1.50	—	—	0.28	0.46	—	—	—	—	0.75	—
		Millimetres	—	38.1	—	—	7.1	11.7	—	—	—	—	19.0	—
8	March	Inches	0.53	—	—	2.29	1.80	1.12	0.06	1.18	—	1.77	1.25	0.84
		Millimetres	13.5	—	—	58.2	45.7	28.5	1.5	29.8	—	45.0	31.74	21.3
9	April	Inches	3.84	6.29	2.40	9.18	3.54	6.19	3.34	8.01	2.46	9.61	5.49	5.08
		Millimetres	97.5	159.8	61.0	233.2	89.9	157.2	84.8	203.8	62.5	244.1	139.5	129.0
10	May	Inches	8.43	2.55	0.49	4.40	19.18	3.33	6.69	5.21	4.96	3.91	5.92	14.49
		Millimetres	214.1	64.8	12.5	111.8	487.2	84.6	169.9	132.3	126.0	99.3	150.4	368.1
11	June	Inches	17.38	13.53	15.36	18.56	20.16	28.30	14.95	20.35	25.57	14.19	18.84	22.22
		Millimetres	441.5	343.7	390.1	471.4	512.1	718.8	379.7	517.1	649.4	360.6	478.5	564.6
12	July	Inches	29.31	27.72	54.99	43.09	9.52	37.61	37.25	50.49	67.65	41.03	39.87	71.73
		Millimetres	744.5	704.1	1,396.1	1,094.5	241.8	955.3	946.1	1,282.4	1,718.2	1,042.1	1,012.7	1,821.9
	Total	Inches	108.42	90.76	119.73	134.51	97.25	115.06	105.10	135.48	137.33	111.92	115.56	162.28
		Millimetres	2,753.9	2,305.3	3,041.1	3,416.3	2,470.1	2,922.5	2,669.5	3,441.4	3,487.8	2,842.9	2,935.2	4,122.5

APPENDIX M—III

Meteorological Data of the Coffee Research Sub-Station, Chethalli—1960-61

Sl. No.	Description		Aug. 1960	Sept. 1960	Oct. 1960	Nov. 1960	Dec. 1960	Jan. 1961	Feb. 1961	March 1961	April 1961	May 1961	June 1961	July 1961
1	Highest Maximum Temperature	C	25.6	27.8	28.9	26.7	27.8	28.3	31.7	32.8	32.2	28.9	26.1	23.3
2	Lowest Maximum Temperature	C	18.3	21.1	20.6	21.1	22.2	21.7	26.1	30.0	26.7	18.9	20.0	18.9
3	Highest Minimum Temperature	C	22.2	20.0	20.0	20.0	18.9	18.3	17.2	19.4	22.8	20.6	21.7	20.0
4	Lowest Minimum Temperature	C	17.2	16.7	13.3	15.0	12.2	11.7	13.3	15.0	16.7	16.7	16.7	16.7
5	Average Maximum Temperature	C	21.7	23.6	25.3	24.2	25.8	26.2	29.0	31.6	27.8	25.5	19.3	20.8
6	Average Minimum Temperature	C	18.7	19.7	16.6	18.5	15.4	15.1	15.5	17.2	18.7	18.7	22.2	18.5
7	Average Humidity	%	81.0	81.0	79.0	83.0	68.0	78.0	73.0	75.0	82.0	83.0	83.0	87.0
8	Number of days on which rainfall was below 10 cents		5	7	3	3	—	—	—	—	6	5	1	1
9	Number of days on which rainfall was between 10 and 50 cents		14	14	6	11	—	2	1	3	6	6	10	9
10	Number of days on which rainfall was between 50 cents and 1"		4	—	1	2	—	—	—	—	4	1	4	8
11	Number of days on which rainfall was between 1" and 2"		1	—	—	—	—	—	—	—	2	4	5	5
12	Number of days on which rainfall was above 2"		—	—	—	—	—	—	—	—	—	3	3	8
13	Number of rainy days during the month ..		24	21	11	16	—	2	1	3	18	19	23	31
14	Highest rainfall during the month	mm.	40.5	10.0	63.0	23.8	—	3.0	11.5	8.5	40.8	93.0	174.0	192.0
		inches	1.60	0.39	2.50	0.93	—	0.12	0.45	0.33	1.60	3.66	6.85	7.56
15	Total rainfall during the month	mm.	217.1	89.7	114.7	115.2	—	5.5	11.5	23.3	197.60	391.2	595.0	1,201.9
		inches	8.55	3.53	4.52	4.54	—	0.22	0.45	0.92	7.78	15.40	23.43	47.31

APPENDIX M—IV

Rainfall Record of Coffee Research Sub-Station, Chethalli—1960-61

Sl. No.	Month		1950-51	1951-52	1952-53	1953-54	1954-55	1955-56	1956-57	1957-58	1958-59	1959-60	Average for 10 years	1960-61
1	August	(mm.)	233.7	168.8	269.2	389.9	308.1	147.8	255.0	283.7	316.7	225.4	259.8	217.1
2	September		351.8	242.3	57.9	45.0	103.6	144.5	63.0	9.4	77.2	235.4	133.0	87.7
3	October		82.5	162.1	209.5	353.3	195.1	273.1	281.9	243.8	95.8	75.0	197.2	114.7
4	November		102.9	85.9	—	—	—	19.1	130.8	105.4	65.8	102.0	61.2	115.2
5	December		—	—	53.6	—	35.3	—	—	—	—	5.5	9.4	—
6	January		—	—	—	—	—	12.7	—	1.3	—	5.0	1.9	5.5
7	February		—	2.3	—	14.7	—	0.8	—	—	—	—	1.8	11.5
8	March		55.1	—	4.6	31.0	11.7	4.6	3.8	15.2	0.5	32.0	15.8	23.3
9	April		60.2	111.0	54.4	117.3	142.5	125.0	62.2	63.5	31.0	116.0	88.3	197.6
10	May		106.4	78.5	26.2	152.1	296.9	74.4	209.3	221.5	110.2	155.0	143.5	391.2
11	June		227.3	202.3	309.1	297.4	331.2	474.2	310.9	261.4	560.3	164.0	313.8	595.5
12	July		529.8	301.2	827.8	651.8	133.3	552.5	565.7	719.6	997.2	669.0	594.8	1,201.0
		Total cms.	175.5	135.6	181.8	205.3	155.8	182.9	188.2	192.5	225.5	178.4	182.1	296.1

SECTION THREE

1. Extension Service:

1.1. The Director of Research exercised overall supervision, direction and co-ordination of the extension activities of the Department. He was assisted for this purpose by the Senior Liaison Officer (Development) at Headquarters, Senior Liaison Officers at the Liaison Divisions and Junior Liaison Officers at Liaison Districts.

1.2. Shri W. Raghavendra Rao continued to be the Senior Liaison Officer (Devt.) at Headquarters till 6th June 1961 when he was relieved to take up his new assignment with the Government of Andhra Pradesh. He was on leave for about a month in Feb./March 1961. During the period of his leave and from 6th June 1961, Shri P. G. Sundareswaran, Liaison Assistant, was in charge of the Development Section at Headquarters.

2. Organisation:

2.1. There has been no change during the year in the organisational set up of the Extension Services of the Department except for a re-alignment of the jurisdictions of the area allotted to the Pulneys and S. Kerala Liaison Districts. The coffee tract in the Bodi and Chinnamanur area have now been taken away from the Pulneys Liaison District and placed in charge of the S. Kerala Liaison District for advisory services. Consequent on this re-adjustment of jurisdictions, the Headquarters of the S. Kerala Liaison District was shifted to Bodinayakanur from Kottayam.

2.2. During the year under report, there were a number of defections from the Extension Wing of the Department. Sarvashri K. T. Bhagath and H. S. Puttaswamy resigned from service to take up employment elsewhere. Shri T. V. Pattabhiraman, Senior Liaison Officer, retired after having served the Department for 14 years. The services of Shri W. Raghavendra Rao, Senior Liaison Officer (Devt.) were lent to the Andhra Pradesh Government for a period of 3 years. The vacancies caused by these could not be filled up immediately and work had to be re-allotted amongst the existing officers. This to a certain extent caused a heavy strain on the resources of the Department.

2.3. The coffee area in South India is divided into 3 Liaison Divisions and 12 Liaison Districts for purposes of administrative convenience and effective advisory work. Each of the Liaison Divisions comprising of 3 or 4 Liaison Districts and covering an area of approximately 75,000 acres of coffee is placed in charge of a Senior Liaison Officer. The Liaison Districts comprising of a homogeneous tract of coffee extending over 20 to 30 thousand acres having as far as possible the same climatic factors are placed in charge of Junior Liaison Officers. The following is a list of the Liaison Divisions and Liaison Districts with their Headquarters:

	Division/District	Headquarters
1	N. Mysore Liaison Division	Hassan
2	S. Mysore Liaison Division	Mercara
3	Madras Liaison Division	Coimbatore
4	Koppa Liaison District	Koppa

	Division/District		Headquarters	
5	Chikmagalur Liaison District		Chikmagalur	N. Mysore Division
6	Mudigere	„	Mudigere	
7	Saklespur	„	Saklespur	
8	N. Coorg	„	Somwarpet	S. Mysore Division
9	S. Coorg	„	Gonicoppal	
10	N. Wynaad	„	Manantoddy	
11	S. Wynaad	„	Kalpetta	
12	Nilgiris	„	Coonoor	Madras Division
13	S. Kerala	„	Bodinayakanur	
14	Pulneys	„	Dindigul	
15	Shevaroys	„	Yercaud	

2.4. The Senior Liaison Officers in charge of Divisions, in addition to their routine Extension and Advisory functions in their personal contact zones extending roughly over 1000 acres of coffee, continued to exercise an effective supervision of the activities in the Liaison Districts in their supervisory charge in achieving a co-ordinated implementation of the several programmes both under the Extension and Development aspects.

3. Growing of Coffee Outside the Established Coffee Belts:

3.1. The Government of Andhra Pradesh under their schemes to provide welfare measures to the Tribal people in the Agency tracts have launched on a programme of planting 170 acres of coffee during 1961-62. On the request of the Andhra Pradesh Government to depute a senior officer of the Board's Research Department for technical advice and on the spot guidance, in their programme of coffee cultivation, the services of Shri W. Raghavendra Rao, Senior Liaison Officer, have been lent. He took up the appointment early in June 1961 as Coffee Specialist under the State Government's Coffee Project Division. Planting of 150 acres with 18-month old bed plants has been completed. The rest of the 20 acres has been proposed to be planted in Aug.-Sept. 1961 with basket plants. Concurrently, bed nurseries to provide enough seedlings for planting an area of 230 acres in 1962 are being raised with the seed material supplied by the Board's Research Department.

3.2. A further area of 122 acres of coffee was planted during 1960 in the Hill Districts of Assam bringing the total acreage to 440 acres. The trial plots laid out in the cinchona plantations area of the West Bengal Government continued to be maintained well. The yield performance and the quality of the produce both in the Hill Districts of Assam and the Darjeeling area (West Bengal) are still under study.

3.3. An area of about 15,000 acres was reported by the officers who conducted a survey of the areas in the Andaman and Nicobar Islands as suited for coffee cultivation. As recommended in the Survey Report, small test trial plots are being laid out in selected blocks.

3.4. The Government of India have appointed Shri S. Sundaram as Coffee Development Officer to take charge of the Scheme of Coffee Cultivation in these Islands.

30.74 litres of seed coffee for raising seedlings to plant about 30 acres as trial blocks have been supplied during 1960-61.

4. Coffee Demonstration Farms:

4.1. The second phase of planting in the Coffee Demonstration Farms at Gonicoppal, Kalpetta and Saklespur and the first phase of planting at Pulneys were completed according to schedule. These plantings are laid out in blocks of 1 to 4 acres in extent to demonstrate the intensive and non-intensive working of an estate inclusive of fertilizer applications, spacing for coffee, the agronomics of coffee culture and plant protection measures. Museum plots are also laid out with a view to study the performances of the different strains in the particular zone and at the same time provide a facility for the local planting community to observe the different varieties bred at the Station and decide the most suitable variety to be grown.

4.2. *Kalpetta:* The final acquisition proceedings regarding the land acquired by the Government of Kerala for the Board to establish the Coffee Demonstration Farm were passed. The total value of the land (20 acres) was fixed at Rs. 6,847.87. The Government of Kerala have kindly waived the payment of land tax as the land was to be used for conducting research and for demonstration of improved methods of coffee cultivation.

4.3. The Farm was formally inaugurated on 6th April 1961 by His Excellency the Governor of Kerala, Shri V. V. Giri.

4.4. The planting of an area of 7 acres was completed in September 1960 bringing the total planted area to 9 acres under Arabica and 5.50 acres under Robusta. An area of about $\frac{1}{2}$ acre is being laid out as a museum plot. The constructions of an Office Building, two sets of Field Staff Quarters and one Stores Building were completed during the year. The Office of the Junior Liaison Officer, S. Wynaad District, Kalpetta, has been shifted to the Farm. The electrification of the staff quarters, labour lines and the office building was completed.

4.5. *Gonicoppal:* An area of 8 acres was planted to Arabica Selections in this Farm. The total planted area is at present 15 acres of Arabica and 3 acres of Robusta. Planting of $\frac{1}{2}$ acre to serve as a museum plot has been taken up. The construction of an Office Building and 2 sets of Field Staff Quarters are nearing completion. The Office of the Junior Liaison Officer, S. Coorg, has been moved to the Coffee Demonstration Farm.

4.6. *Saklespur:* An area of 2 acres was planted during the year. Thus 5 acres under Arabica and $1\frac{1}{2}$ acres under Robusta have been planted in the Farm. Three acres as a manurial demonstration plot and $\frac{1}{2}$ acre as a museum plot are being laid out and planting is expected to be completed by September 1961. The constructions of an Office Building and 2 sets of Field Staff Quarters are in progress.

4.7. *Pulneys:* An area of 6 acres was planted in the Coffee Demonstration Farm, Pulneys (Thadiankurissi). In this Farm, the sinking of a well has been completed and the construction of a Stores Building is nearing completion. Construction of a pump house, water reservoir, a labour line, staff quarters and office building are to be taken up in the coming year.

4.8. *Shevaroys:* An area of 30 acres with 13 acres of bearing coffee was purchased in Yercaud for setting up a Coffee Demonstration Farm for the Shevaroys Liaison District. The programme in this Farm for the year has been confined to the consolidation and rehabilitation of the old coffee by demonstrating the improved methods of coffee culture by adhering to a planned programme of various cultural, manurial and plant protection operation in proper time. An area of 5 acres is proposed to be newly planted during the coming year. The construction of a store house, sinking of a well and the formation of an approach road to the Farm have been taken up.

5. Development Plan:

5.1. The schemes relating to collection and distribution of seed coffee, establishment of co-operative and individual pulping units for processing of coffee to increase the production of quality coffee for the market, and the accelerated programme of demonstration of the improved techniques of coffee cultivation continued to be operated directly by the Research Department. The progress achieved in the working of these schemes is hereunder reviewed in brief:

5.2. *Collection and Distribution of Seed Coffee:* A total quantity of 11,129 lb. of seed coffee was distributed to 2,142 growers during the 1960-61 season. This comprised of 10,440 lb. of high yielding Arabica Station Selections bred for leaf disease (H. Vastatrix) resistance and of 689 lb. of Robusta and Excelsa coffee. The seeds for the purpose were produced from the Board's main Research Station at Balehonnur, the Sub-Station at Chethalli and from 13 Regional Seed Plots established in private estates. In order to make the seeds available to the planter as near to his plantation as possible, the distribution was arranged from 14 distributing centres located in the different parts of the coffee tracts in S. India and from the main Research Station.

5.2.1. In recent years, the Department has been aiming at a reduction in the acreages under Robusta so as to minimise as far as possible the production of inferior quality coffees. By counselling and sound reasoning, a gradual restraint has been created in this behalf. This can be seen from a fall in the demand of Robusta seed material during the year. As against an original demand (received during July/October 1960) for 1,100 lb. of seeds of Robusta, the actual need, at the time of distribution in Feb./March 1961 came down to 672 lb. It has been decided to confine the distribution of Robusta seed material during the coming seasons only for supply planting purposes.

5.2.2. The implementation of the phased programme of re-introducing Arabica in the erstwhile Arabica tracts which had fallen a prey in the last decades of the last century to the ravages of leaf diseases and had taken to extensive cultivation of Robusta, has been intensified and speeded up. This programme is carried out by inter-planting, replanting of the Robusta blocks and also by conversion of the Robusta bushes to Arabica by grafting. The results of this programme are highlighted in the Malabar Wynaad area which has now nearly 2,000 acres of young and vigorous Arabica coffee as against a negligible acreage of less than 50 acres in the early part of the last decade.

5.2.3. The performance of the improved strains of Arabica bred at the Station for resistance to leaf disease with high yielding potential and which can successfully be

grown in areas once adjudged not to possess the optimal conditions for Arabica cultivation, has in no small measure contributed to encourage the planting community to convert their existing blocks of Robusta to Arabica and to resort to any extension with only the Station Selection Arabica plant material.

5.2.4. The study and observations conducted during the year further confirm that the Station Selections possess high and even bearing capacities, they establish well in varying types of soil and climatic conditions, they are able to withstand adverse weather conditions and in addition to being resistant to the leaf disease, are generally very vigorous.

5.2.5. The distribution of seeds of Arabica Station Selection by the Department from 1943 onwards is roughly 77,000 lb. With this material, the area planted to improved strains of coffee can safely be placed at 65,000 acres allowing for losses in germination, mortality in the nursery and post planting stages in the field. This does not however take into consideration the exchange of a substantial quantity of seed coffee taking place among the planters.

5.2.6. Raising of seedlings of the disease resistant Arabica Station Selections and of the high yielding Robusta was continued in the Coffee Demonstration Farms. 20,350 seedlings were sold to planters from these nurseries during the year. About 50,000 seedlings were raised in 4 centres during the year for distribution to planters in August/September 1961. The sale is effected at the rates prevailing in the area for such seedlings and on a no-loss basis to the Department.

5.2.7. Statements indicating the year-war distribution of seed coffee from 1943 to 1961 are furnished in Appendices II, III and IV.

5.3. *Establishment of Co-operative and Individual Pulping Units:* With a view to increase the inflow of more and more of quality coffee into the market, Scheme V of the Development Plan envisaged the setting up of a number of pulping units on a co-operative basis and also in individual holdings. Intensive propaganda by the Extension Wing combined with timely technical advice and guidance in the correct methods of coffee processing contributed in no small measure in converting the planters, especially peasant farmers "parchment conscious."

5.3.1. The processing of coffee by the old method by itself alone does not assure quality but has to be followed by proper drying in well maintained drying yards. This fact also formed part of the propaganda and advice undertaken by the Extension Staff in order that the inherent characteristics of Indian coffee may not be lost by defective drying.

5.3.2. Financial assistance was offered to 61 planters during the year under report to set up their own pulping units. This assistance was in the form of purchasing suitable pulpers and ancillary equipments and supplying these to the planters on Hire Purchase System.

5.3.3. The approximate value of such equipments issued by the Department on Hire Purchase terms during the 3 years of working of this Scheme was as under:

1958-59	.. Rs.	15,700
1959-60	.. Rs.	35,500
1960-61	.. Rs.	1,47,300

5.3.4. Five out of six co-operative pulping units and 17 individual units established in the previous years functioned during 1960-61.

5.3.5. Over 1,25,000 bushels of fruits were converted into parchment from these pulping units. This works out to about 500 tons of clean quality coffee.

5.3.6. The supply of spraying equipment and machinery on similar Hire Purchase terms has been initiated from this year. Over 70 applications have so far been received from planters for supply pulping and spraying machineries during the 1961-62 season.

6. Accelerated Programme of Demonstrations:

6.1. The number of demonstration plots laid out in the planters' fields in each of the sub-zones of the Liaison Districts stood at 300 at the end of the year under report. These demonstration plots continued to attract many planters in the neighbourhood which in turn have paved the way for a number of peasant holdings to adopt the improved methods of cultivation. It is heartening to record the increasing and incessant demands from small scale planters for visits to their holding by the Extension Staff to assess the results of their work and for offering suggestions for further improvements and upgrading.

6.2. The total number of estates which have received loan from the Board for intensive cultivation was 307. Suitable calendars of operations were issued to these estates by the Extension Staff. These estates were visited periodically by the Extension Staff and the progress achieved by working to the schedule of operations was assessed and recorded.

6.3. The distribution of the demonstration plots and loan-aided estates in the Liaison Districts is given in Appendix V.

7. Incidence of Pests and Diseases:

7.1. Periodical surveys to assess the pests and diseases incidences continued to form a part of the routine advisory work of the Liaison Wing. This enabled a correct appraisal of the pests and diseases position in different coffee zones based on which timely plant protection measures were advocated.

7.2. As in the past years, eelworms maintained a major pest status. The incidence of shot hole borer attained markedly high proportions at Wynaad, South Coorg, Saklespur, Koppa, Anamalais and Nilgiris (Gudalur area). Greenbug incidence was in general high in Nilgiris, while heavy but sporadic outbreaks occurred in Shevaroys, Pulneys, North Coorg, Saklespur, Chikmagalur, Koppa zones. The incidence of red borer was negligible in most zones though stray infestations were encountered at North Coorg. Severe incidence of white stem borer was observed in Chikmagalur and at lower elevations of Kilkotagiri and Nilgiris. Incidence of hairy caterpillars was observed in

a few estates in Nilgiris and in young clearings in Wynaad and South Coorg. Aphids, leaf hoppers, mealy bugs and thrips were prevalent from September in many coffee zones. Incidence of the latter was reported noticeably high in several estates in North Wynaad, Saklespur, North Coorg and Nilgiris. Leaf hoppers too were equally abundant.

7.3. An early and fairly severe outbreak of leaf rust disease was experienced during 1960 post-monsoon period, causing considerable defoliation and Die-back in most of the South-West monsoon coffee areas. During the current season also, indications are that serious outbreaks of leaf disease could be anticipated in most of the South-West monsoon coffee areas as the monsoon tails off. In the North-East monsoon areas, the disease was well under control except in neglected plantations where timely protective Bordeaux spraying operations were not taken up. Incidences of black rot were mild and mostly limited to endemic zones during 1960 South-West monsoon period; however, during July-August 1961 period, wide-spread occurrences causing considerable damage have been encountered in most coffee zones predominantly under South-West monsoon. The continuous heavy rains and cloudy days with saturated atmospheric conditions favoured the incidence of the disease. Incidences of damping off in nurseries, kondli in nurseries and clearings and other minor diseases like pink disease and rot diseases, though noticed, have been negligible in most zones. Brown-eye-spot disease in nurseries and clearings and berry blotch disease in bearing fields were noticed in most plantations under South-West monsoon influence and such incidences were particularly wide-spread and serious in Mudigere, Koppa, South Coorg and North and South Kerala Zones. The new malady on Die-back complex reported during pre-monsoon post-blossom period of 1960 from most of coffee areas continued to exhibit itself during the current year also, but the intensity appears to have subsided considerably. Though death of tertiary branches were encountered, the leaf and branch malformations said to be associated with the malady was comparatively much less during the current season. It is heartening to note that considerable recovery was noticed on the plants affected with this malady during 1960 season.

8. General:

8.1. During the months of June and July, an immensely heavy rainfall was recored in most of the South-West monsoon areas. Land slides have occurred in many estates in the Mudigere Liaison District. It is estimated that about 1,000 acres of coffee has been lost. Damages to properties within the estate, i.e., to labour lines, residential quarters, drying yards etc., have been reported. Owing to continuous rains in these areas, development of Robusta has been very halting. In the case of susceptible Arabica coffee, serious droppings have occurred. These may cause a reduction in the crop estimated at blossom.

8.2. Deficiency diseases due to sub-optimal nutrition of either major or minor elements are being noticed all over the coffee areas. It would appear that owing to the thinning out of shade and the increased use of fertilizers in producing heavier yields than previously and also because of the nature of the soil, the nutrition of the plant in many areas appears to be deficient with respect to zinc. A rapid survey is being undertaken to

assess such deficiencies and advice is being offered wherever such mal-nutrition is observed to overcome it by foliar application of zinc sulphate.

8.3. The advisory activities of the Liaison service flanked in various directions were mainly centred around request visits and study tours of the coffee estates and areas, demonstrations in the field of the various cultural operations inclusive of the use of fertilizers, chemicals and machineries in coffee plantations, discussions with groups of planters and issue of advisory and warning notes on the incidence of pests and diseases and their control measures. The following is a data of such activities:

1	No. of demonstrations on improved methods of cultivation held ..	887
2	No. of group gatherings addressed	214
3	No. of estates where grafting demonstrations were conducted ..	10
4	No. of estates visited for spot inspections to assess the suitability for grants-in-aid under the Development Plan	187
5	No. of follow-up visits paid to loan aided estates	757
6	No. of estates (other than loan aided estates) visited on request and for study of problems	4,329
7	No. of advisory notes issued (in person and by correspondence)	7,747

N. G. CHOKKANNA,
Director of Research

SECTION FOUR

A — SUMMARY OF RESEARCH

1. Agronomy:

1.1. During the year Research in Agronomy Division was mainly devoted to the Field Observations. Eleven long term experiments which were in progress were continued. Crop estimation studies initiated earlier were continued at the two Research Stations and in selected estates of different Liaison Districts.

1.2. The experiments on soil cultivation practices, Robusta manuring, mulching young Arabica coffee etc., did not show statistical significance.

1.3. The outcome of field observations were quite valuable and contributed to the better understanding of leaf disease spore dispersal, thrips incidence and associated symptoms.

1.4. The Result Demonstration Blocks and the Intensive Cultivation Trials brought to light the possible importance of insecticidal sprays along with the increased rounds of Bordeaux mixture application, to effectively control thrips species and thereby leaf disease spore dispersal. These combination sprays in turn appear to check the usual premature leaf fall of old coffee.

1.5. Apart from the field experimentations, nursery trials conducted by this Division, have given certain indications in the use of hormones. They appear to help in early emergence of seedlings which in turn facilitates early transplanting of seedlings into the baskets.

1.6. Phytotoxic studies on coffee using BHC, have revealed that root abnormalities are caused in seedlings, the interveinal chlorosis of young leaves and the pith browning of coffee twigs. Further there are indications to suggest that BHC swabbed to coffee stems are translocated to untreated parts. This indication might be useful to correlate the brickly flavour of our coffee often reported by cup tasters.

1.7. Weedicide trials with Dowpon have given positive results in the control of grasses; but the phytotoxic effect on the associated dadap and other shade trees of coffee are under critical evaluation.

1.8. The Result Demonstration Blocks laid out as a project study to assess the physiological aspect were continued.

1.9. Malformations and virus-like symptoms and their pertinent transmission studies with the grafted material though continued did not give any indication to show the Sun dry condition of certain coffee bushes is due to virus. The necessary transmission of the disease symptoms have not occurred so far to healthy parts which eliminates the angle of the problem.

1.10. Further A-normal growth and other associated symptoms appear to be associated with certain species of thrips prevalent in coffee plantations of South India.

Certain preliminary indications are recorded to show that the triage problem might be connected with the incidence of blossom visiting thrips.

1.11. Observations on the effect of slow sprinkling overhead irrigation of Robusta and Arabica coffee were continued and described in detail.

2. Botany:

2.1. Breeding of coffee with an attempt to improve it in vigour, resistance to leaf disease and giving consistent high yields of good quality beans was continued by continuation of (a) establishment of genebank of plant material from countries outside India and from Indian sources, (b) comparative trials of selections, (c) cytological and embryological studies, (d) study of reaction of selections to races of leaf disease, (e) vegetative propagation of coffee, and (f) examination of seed plots of approved selections for collection of seed for supplies to growers.

2.2. Through the kindness of Dr. Branquinho d' Oliveira, additions were made to the genebank during the year which consisted of "*Hibrido De Timor*" said to be immune to all the eleven races of leaf disease, 134 *S. 12 Kaffa* and its progeny said to be resistant to all but the X race, and *C. racemosa*. In the Arabica collections from countries outside India those from Ethiopia like *Kaffa*, *Tafarikela*, as well as *Rume* and *Barbuk* continued to show either freedom from leaf disease in the field or great resistance. Among the earlier planted ones, *Kaffa*, *Tafarikela*, *Philippinean* and *Blue Mountain* recorded yields ranging from 7-12 cwts/acre. Their coffee is of F.A. Quality.

2.3. From 1953 to 1960 thirty-three collections from marked plants in estates were established at the Station. A few selected individual plants in these showing field resistance to leaf disease and good bearing have been retained and the rest discarded since they show high ununiformity, high leaf disease and defective cropping. Further collections from 8 estates have been established from 1960 for their performance behaviour.

2.4. *Rume* and *Barbuk* exhibiting freedom from leaf disease in the field, pedigree Kent, and a promising collection from Flora Estate in West Mysore were used during the year for effecting six cross combinations.

2.5. Out of 61 intra-crosses between Arabica selections and collections established from 1952 to 1958 and retained for observations, nine continue to show promise. B.A. 21×B.A. 16 planted in 1952, shows 6.6% leaf disease susceptibility in the field and recorded during the year 13.2 cwts/acre against 5 years average of 4.7. cwts/acre. B.A. 21×B.A. 9 planted in 1953 shows 15.9% leaf disease susceptibility and recorded 6.7 cwts/acre during the year against 4 years average at 3.0 cwts/acre. B.A. 22×B.A. 12 planted in 1955, S.576×S.583 planted in 1956, B.A. 13×1st Gen. of S.178, 1st Gen. of S.178×(S.26×Kent), S.576×S.795 planted in 1957 show vigorous growth. The high degree of uniformity in the population of S.576×S.583 is worth recording.

2.6. In the cultures planted in 1954, upto 75% leaf disease susceptibility was recorded during the year. Laboratory tests indicate that race IV is responsible for this and that it may be gaining ground in the North and North-Easterly portions of the Station.

2.7. (a) Laboratory tests show that in the 1st Gen. of S.795 upto 16% plants are susceptible to the common race II occurring on Kent. The rest are resistant to this. On an average of 5 years the cultures have yielded from 5 to 6.9 cwts/acre.

(b) The 2nd Gen. cultures of S.795 maintain vigorous growth. Under field conditions during the year a few spots of leaf disease on a few leaves were seen in upto 44.7% plants. Laboratory tests are in progress to identify the race. These cultures gave a first full crop between 3.6 to 7.4 cwts/acre.

2.8. In the Latin Square trial at Coffee Research Sub-Station, Chethalli, started in 1949, on the average of 10 years yields, S.795 leads with 10.8 cwts/acre, followed in order by S.645 with 8.4 cwts/acre, S.288 with 7.2 cwts/acre and S.446 with 5.9 cwts/acre.

2.9. (a) In the B.A. series trials to isolate best performers B.A. 12 and B.A. 18 with over 5 cwts/acre lead closely followed by B.A. 11, 19, 20, 13, 23, 36, 1, 28, 9 and 16.

(b) In the B.R. series trials to isolate best performers B.R. 12, 9, 6 with over 4.6 cwts/acre lead closely followed by B.R. 14 and 10.

2.10. In the progeny from selected plants in B.C. 2 and B.C. 3 (*Robusta*×*Kents arabica* back-crossed with *Kents arabica*), established in 1959, a high uniformity in the population as well as vigorous growth and comparative freedom from leaf disease in the field is observed. Also, these cultures bear close resemblance to Arabica.

2.11. In the F1 of *C. liberica*×*C. eugenioides* a mixo-ploid plant was seen. In this tetraploid suckers arose. These bear very close resemblance to *C. arabica* in morphological features. This is a major find and gives indications on the origin of *C. arabica* supporting the view that this species is an allotetraploid. Under laboratory test this plant shows susceptibility to race II while repeated inoculations with race IV have been failures.

2.12. Consequent on the appointment of an Asst. Botanist, the scheme of testing of selections against races of the leaf disease fungus was re-commenced from November 1960. Races I, II and IV have been isolated, and, parent of S.795, S.795 and its progeny are being tested with races II and IV. Parental culture of S. 795 as well as S. 795 show upto 23.5% plants susceptible to race II occurring on *Kents*; 1st Gen. of S. 795 shows upto 17.4% plants susceptible to this race and in the culture in the 2nd Gen. so far tested upto 6.8% plants show susceptibility to race II. No plant resistant to race IV has been found so far in these cultures.

2.13. A haploid (2n=22) plant in each of *Kent* and S. 795, and a hexaploid (2n=66) plant in the progeny of each of S. 288-23, B.A. 1 and S. 795 have been marked. Haploids show irregularity in the meiotic divisions. In the progeny of the haploid *Kent*, in some seedlings normal tetraploidy (2n=44) has been restored.

2.14. Chromatin bridges are noticed in *C. excelsa*, *C. eugenioides*, and in the F1 plants of *C. liberica*×*C. eugenioides* and *C. excelsa*×*C. eugenioides* examined.

2.15. From an analysis of triage carried out from 1958, it is found that more than one factor is responsible for triage. Upto $\frac{1}{2}$ of the total triage in the Station Selections

studied and upto $^1/_3$ in *Coorg* and *Kent* Arabica are due to elephant, malformed and other abnormal beans which develop due to false polyembryony (initiation of more than one ovule per locule) and defective endosperm. These components show seasonal fluctuations. The remaining quantities of the total triage are due to environmental and crop processing conditions. In the case of Station Selections, especially S. 795, there are indications as in its 1st and 2nd generation, that it may be possible to reduce by further selections false polyembryony to bring it to the level found in *Coorg* and *Kent*.

2.16. The standardised technique for conversion of *robusta* and hybrid stocks without stumping them, by wedge grafting green tender suckers arising on the main stem at 12 to 15 inches from ground level, is being increasingly adopted in estates. This has come in handy in reclaiming eelworm infested fields where grafts on *robusta* stocks are under establishment. The technique is also extended to convert the crown of leaf disease susceptible segregates in blocks of Station Selections with scion from resistant plants.

2.17. In addition to the existing 8 regional seed plots six more were added so as to enable the requirements of each region being met with from seed produced in the seed plots of the same region. Sample seeds were supplied to Ceylon, East Pakistan, Indonesia and Rust Research Centre, Portugal.

2.18. Experiment laid out to compare the performance of both *arabica* and *robusta* trained on the multiple stem system as against the common practice of growing coffee on single stems, showed that in the case of *arabica* over a period of ten years practically no differences in yields were noticeable whereas in the case of *robusta* over a period of nine years, due to heavy incidence of shot-hole borer infection in the multiple stems, the yield from these plots is 29.6% less than a single stem plots.

2.19. A good collection of shade trees from sources in and outside India is being maintained as foundation stock. Seeds of *Maesopsis eminii* were supplied to Agricultural Botanist, Cinchona, Coimbatore District, Madras State and seeds of *Albizzia maranguensis* to Kodeneri Estate, Nilgiris, Madras State.

3. Chemistry:

3.1. Experiments on the manurial requirement of coffee, influence of trace elements on growth and vigour, land management with stress on soil and moisture conservation and studies on the processing of coffee were continued.

3.2. Manurial experiments to study the essential requirement of major plant foods either singly or in combination has completed 21 years. It is noticed from the yield data that Nitrogen in combination with Phosphorus has consistently recorded high yields and crop increases are commensurate with the increase in application of nitrogenous fertilisers.

3.3. Fundamental manurial experiments on the application of varying levels and combinations of Nitrogen, Phosphorus and Potassium were continued. Trials on varying doses of Nitrogen from 40 lb. to 100 lb. with fixed levels of Phosphorus and Potassium, trials with different sources of Nitrogen and trials with varying levels of Phos-

phorus and Potassium with a fixed level of Nitrogen were continued. These trials bring out the relative importance of a balanced fertiliser application.

3.4. Field trials to find out the economic dose of Nitrogen and the role of Phosphorus and Potassium in the utilization of Nitrogen were continued.

3.5. Field manurial trials on Robusta to study the application of different levels of Nitrogen from 40 lb. to 100 lb. with fixed levels of Phosphorus and Potassium were continued. These bring out the importance of split doses of Nitrogen with adequate quantities of Phosphorus and Potassium. Field trials on the effect of varying and fixed levels of Nitrogen, Phosphorus and Potassium on the growth and yield of Robusta coffee were continued.

3.6. Field and pot trials to study the effect of Chelated and trace elements on the growth, vigour and yield of coffee were continued. Observational trials with foliar sprays of trace elements in a private estate in Kalasa area brought out that the plants were suffering from Zinc deficiency which responded very well to Zinc Sulphate sprays. Similar observational trials are under progress on the Station on plants having both die-back and malformation of leaves.

3.7. Studies on the foliar absorption of plant nutrients show that dilute solutions of plant nutrients are better accepted than concentrated solutions, as these cause severe leaf burning. Nitrogen and Phosphorus appear to be better absorbed when an NPK mixture is applied, there being very little absorption of Potassium. Nitrogen appears to respond better than Phosphorus and Potassium when applied as a foliar spray.

3.8. Studies on the diurnal variation of plant nutrients in coffee brings out that there appears to be no correlation between plant nutrients and the diurnal factors such as light intensity, temperature and humidity.

3.9. Seasonal variations of plant nutrients in coffee leaf bring out the importance of the application of fertilisers in February-March, May-June and September-October, as plant foods are in greater demand during these periods and would be better utilised.

3.10. Studies on plant nutrient status of World Collections of Arabica Coffee as compared to established older coffees, *viz.*, Kent's and Coorg's, and also Station Selections, show that the Nitrogen status is high in Kent's and Coorg's, and is comparatively low in the other Arabicas from the "World Collections" and Station Selections. There appears to be no appreciable differences in Phosphorus and Calcium contents between Arabicas in the "World Collections" and the established older coffees. Potassium is fairly high in Arabicas in "World Collections" and is on par with the Coorg's, and is comparatively lower in Kent's and Station Selections.

4. Entomology:

4.1. *Survey:* Survey on the intensity of incidence of pests of coffee was continued. Further *eelworm* infected localities in Pulneys, Wynaad, Nilgiris and North and South Mysore were detected. The incidence of *shot hole borer* was markedly high in Wynaad, South Coorg, Saklespur, Koppa, Annamalais and Nilgiris in the latter half

of 1960. Studies showed that prevalence of high and continuous rainfall in a year retarded the intensity of incidence in the following season while low and intermittent rainfall, with comparatively high temperatures accelerated the intensity. *Green bug* incidence was high at Nilgiris during September-December while in Shevaroys, Pulneys, North Coorg, Saklespur, Chikmagalur and Koppa zones heavy but sporadic outbreaks occurred in early 1961. Incidence of *red borer* was, in general, negligible. Severe incidence of *white stem borer* was reported at Chikmagalur and at lower elevations of Kilkotagiri and Nilgiris. Stray incidence of *hairy caterpillar* was observed in a few estates in Nilgiris and young clearings in Wynaad and South Coorg. Aphids, leaf hoppers, mealy bugs and thrips were prevalent in September at many coffee zones. Incidence of the latter was reported noticeably high while leaf hoppers were equally abundant in some cases. Increased incidence of *grass hopper* was reported from localities in Chikmagalur and Mudigere.

4.2. *Applied Research:* Two *white stem borer* control experiments were in progress to find out the effect of new insecticides, applied in various sequences, on borer incidence. Studies on the effect of B.H.C. swab on cup quality evidenced that two swabs promoted taint. Studies on the rate of build up of *white stem borer* on coffee in blocks that earlier received full complement of swabs but later only selected seasonal swabs, were in progress. Extended field trials with organo-phosphorus and chlorinated hydrocarbon insecticides on the *green bug* indicated that Paramar and Fosferno (Parathion) were the most promising insecticides. The systemic insecticides, Rogor, Meta-iso-Systox and Ekatin did not effect economic control of *shot hole borer*. Trials with Dieldrin, Gusathion (with and without Bordeaux mixture) and W.L. 1650 were commenced to assess the effectiveness of the chemicals on *shot hole borer*. Results indicated that two sprays of Dieldrin with Bordeaux mixture, at monthly intervals, effected significant reduction in infestation and in pest population. Field trials on *root mealy bug* showed that Fosferno (Parathion) possessed maximum effectiveness to control the species as compared to the rest, of which Basudin, Paramar (organo-phosphates) and W.L. 1650 (chlorinated hydrocarbon) were more effective. Laboratory trials with insecticides on *aphids* showed that Malathion and Parathion formulations effected appreciable control on the pest species within 12 hours after treatment. On *hairy caterpillars* Basudin, Folidol, Gusathion and Paramar exhibited significant knock down action. Field trials on the control of *eelworms* did not provide significant results. However, it was found that there was an inverse correlation between predator and parasite populations. The equilibrium, in predator parasite population that was evident towards the close of the trials apparently contributed to the better growth conditions of coffee bushes in various plots. Exploratory pot trials with the nematicides, Nemagon and E.N. 18133 and the insecticides, Meta-iso-Systox, Ekatin and Malathion indicated that the former two were superior to the rest in controlling *eelworms*. Trials with Basudin, Fosferno, Gusathion and Paramar on *eelworm* control proved inconclusive. Trials were in progress to evaluate the effect of Dieldrex, Ekatox, Malathion, W.L. 1650 and PP 175, applied as sprays in various periods, on the incidence of *thrips*, *hoppers* and *mites*. Studies were also commenced to ascertain the phytotoxic effects of B.H.C., Lindane, Dieldrin and D.D.T., if any, on coffee. Data obtained so far indicated that B.H.C. applied as drench produced phytotoxicity.

4.3. *Basic Research:* Studies on the habits, life history and ecological relation-

ships of the *red borer, shot hole borer* and *dadap borer* were continued. Routine collections of insects yielded several new species some of which were known to possess phytophagous habits, *e.g.*, aphids, leaf hoppers, thrips, stink bugs and weevils. Field studies on the distribution and relative pathogenicity of *eelworms* brought to light several new species. Of these, field evidences suggested the pathogenicity of *Rotylenchulus* sp. on Arabica coffee. Further studies are planned.

5. Mycology:

5.1. Investigations on the various diseases affecting coffee in South India with regard to the life histories of the causative agencies and formulation of effective economic control measures continued to be the main pre-occupations of this Division. As part of routine advisory work, surveys on the incidence of various diseases in different zones, examination of diseased specimens and issue of suitable disease control measures were also taken up.

5.2. An early and fairly severe outbreak of leaf rust disease was experienced during 1960 post-monsoon period, causing considerable defoliation and die-back in most of the South-West monsoon coffee areas. During this season also, indications are that serious outbreaks of leaf disease may be experienced in most of the South-West monsoon coffee areas as the rains slacken. Consequent on the continuous heavy rains and cloudy days with saturated atmospheric conditions, Black rot incidence has been widespread in South-West monsoon coffee areas during July-August 1961. Incidences of Damping off in nurseries, Brown-eye-spot in nurseries and clearings and Die-back complex though noticed in most zones, have been mild in general; however, in certain localised patches considerable damage has resulted.

5.3. A brief summary of the salient features of the investigations undertaken on Leaf rust disease, Berry blotch disease, Brown-eye-spot disease, Stem-wasting or Kondli disease, Die-back complex and Damping off is furnished below.

5.4. The relative efficacy of different proprietary fungicidal formulations with regard to leaf rust disease control was compared with that of 0.5% Bordeaux mixture, now in common use, through field trials conducted at the two Research Stations as well as in different coffee zones. In most of these trials, the differences between the proprietary formulations and Bordeaux mixture with regard to leaf retention and crop yields were not statistically significant; however, a trend towards better results while using the latter was often observed. Similar trends were noticed in previous years' trials also.

5.5. Field trials conducted to find out the utility of spraying leaf disease resistant selections have given conflicting results and hence no conclusions could be drawn. Results of observations in a trial conducted to determine the optimum frequency and timings of Bordeaux spray for leaf disease control indicated that incorporation of a pre-blossom spray in addition to the usual pre- and post-monsoon rounds have given comparatively good results. A field trial has been started during 1961 pre-monsoon period to find out whether types of Bordeaux, viz., acidic, neutral and alkaline, prepared by different methods of mixing the ingredients exert any influence on the degree of control of leaf disease. Results are awaited.

5.6. Observations in the trials on control of Berry blotch disease through application of fungicidal formulations in different concentrations have shown that fungicidal sprays controlled the disease to a considerable extent. Copper fungicides were more effective than organic fungicides and ultra-sulphur. Two spray applications with 1% Bordeaux, once in June and again in September effected maximum disease control. To find out the critical periods at which fungicidal sprays effected maximum disease control, another trial was conducted with different spray timings. The results indicated that June-July period was the critical period for effective disease control. Fungicides applied later than August did not effect any appreciable disease control.

5.7. Earlier trials on control of Brown-eye-spot disease have shown that spray applications with Bordeaux, Flit-406 or Dithane M-22 at fortnightly to monthly intervals from April to November period effected good control. To find out the critical periods at which fungicidal sprays would give maximum disease control and thereby limit spray applications to such critical periods ensuring economy, a trial incorporating different spray schedules has been started during this pre-monsoon period. Results are awaited.

5.8. In view of the widespred and serious occurrences of Kondli disease in many coffee zones, the detailed investigations on the cause of the malady and formulation of control measures started in previous season were continued. Examination of malformed tissues of Kondli affected seedlings continued to show the same micro-organisms as reported earlier, *viz.*, *Chaetophoma* sp., *Fusarium* sp., *Phoma* sp. and a bacterium. Trials conducted to find out whether Kondli is caused by a parasitic agency or not, by growing seedlings in sterile soil conditions indicated that the possibility of an infective nature of the disease appeared very remote. From sap inoculations and graftings taken up with diseased material on healthy seedlings since no transmissibility of the disease could be obtained, Kondli does not appear to be of virus origin. In an attempt to reproduce Kondli symptoms artificially, different micro-organisms found associated with Kondli affected seedlings were inoculated on healthy seedlings at monthly intervals during March to August. In all these trials, all the organisms used for inoculation proved nonpathogenic.

5.9. Influence of application of different fertilizers and methods of application on kondli incidence also was tried and the results showed that the type of nutrition had no direct influence on kondli incidence. Failing to establish an infective nature of kondli disease and since no direct influence of type of nutrition on kondli incidence could be noticed, the aspect of influence of Bordeaux application to nursery seedlings on the incidence of the malady was explored at great detail. Trials were conducted on the influence of frequency of application, period of application, and volume of application of Bordeaux mixture on incidence of kondli. The results have shown that incidence of kondli is interlinked with application of Bordeaux mixture and that—

(1) 6, 5, 4 and 3 applications of Bordeaux resulted in heavy incidence of kondli, in two applications it was comparatively less whereas in single spray and no spray treatments, no kondli was noticed.

(2) applications of Bordeaux during May, June, July, August months resulted in heavy incidence of kondli, June and July being the critical

months. Applications of Bordeaux during the months of March and April did not result in incidence of kondli.

(3) The higher the volume of Bordeaux applied, the greater the percentage of incidence of kondli noticed.

5.10. The influence of applications of different fungicidal and insecticidal formulations on incidence of kondli was also tried. In two nursery trials, 13 different chemicals were put to test. The results have shown a positive correlation between frequent application of Bordeaux on other copper formulations to incidence of kondli; no incidence being noticed in unsprayed plots as well as plots sprayed with non-copper containing formulations. Five different Arabica varieties tried showed susceptibility to kondli, when Bordeaux was applied, whereas Robusta remained free.

5.11. The new malady or die-back complex which caused great concern, was investigated at great detail since 1960 pre-monsoon period. Die-back affected twigs showed association of different micro-organisms, *viz.*, *Colletotrichum* types, *Fusarium* sp., *Cladosporium* sp., *Cercospora* sp., *Stemphyllium* sp., *Verticillium* sp., *Diplodia* sp., *Phoma* sp., *Kutilakesopsis* sp., and two types of bacteria, *Colletotrichum* being the predominant one in most cases. In an attempt to find out whether this malady is caused by an infective agent, artificial inoculations were carried out on Arabica plants differing in age, vigour, shade condition etc., using the various micro-organisms isolated from naturally affected tissues. Results of these trials indicated that none of these organisms used for artificial inoculation were agencies capable of reproducing the malady under the conditions tried. The possibility of a virus principle involved in this malady was also investigated through plant sap inoculations and grafting, but no transmission of the symptoms of the malady occurred in any of the trials. Results of trials on possibility of control of the malady through application of fungicidal formulations have given rather conflicting results; however, the trend would appear to be that fungicidal sprays may not effect any appreciable control of the malady. The possibility of a root pathogen involved in the causation of this malady and the possibility of its control through soil application of a fumigant fungicide—Para-dichloro-benzene—were also explored. Trials have been started only recently and hence it is too early to draw any conclusions from the preliminary results. The efficacy of 11 fungicidal formulations in checking the growth of *Rhizoctonia solani*, the causative agent of Damping off of nursery seedlings was tried in artificial culture media. While no fungitoxic effect was noticed with any of the chemicals tried, Terrachlor, Tillex, Bordeaux, Allisan and Ferbam, showed a certain amount of fungistatic effect, Terrachlor being the most effective. Trials were also conducted in the nursery with different fungicides to study their efficacy of control of Damping off and their duration of toxicity. It was noticed that Terrachlor protected the seedlings from Damping off for a period ranging from 40 to 60 days whereas with Bordeaux the duration of toxicity was not more than 20 to 30 days. The other chemicals tried were either ineffective in controlling the disease effectively or proved phytotoxic to the seedlings. In another nursery trial conducted to find out the influence of age of seedlings to the disease incidence, it was noticed that, seedlings in *button* and cotyledary stages were highly susceptible to the disease and that seedlings with two pairs of leaves or more did not often take up the infection.

B—DETAILED SECTION REPORTS

I. AGRONOMY

1. Spacing, varietal and manurial experiments on regional basis were started at the existing Coffee Demonstration Farms. The long term experiments already reported in earlier reports are being continued. This year apart from yield data growth measurements and available soil moisture percentages from different plots were recorded especially in soil cultivation experiment located at the Coffee Research Station.

2. Studies on crop estimation, growing of coffee on Brazilian system and germination studies are being continued.

3. Apart from this, observational studies on A—normal growth and new malady affecting coffee were undertaken as a routine work of this Division and the resultant observations were published from time to time.

4. Phytotoxic studies with BHC (50% wettable powder) on coffee were undertaken.

5. Hormone treatments reported earlier were followed up by spray application of these hormones to the seedlings transplanted into the secondary nursery beds. The growth characteristics indicated by these hormones were also under study. Further, weedicide trials using Dowpon are being continued on regional basis.

6. Observational studies to find out the response of artificial irrigation using overhead sprinkler irrigation unit are being continued.

7. The relevant findings from these experiments are presented in the following pages.

FIELD EXPERIMENTS

8. Studies on the influence of varying Soil Cultivation practices on the yield of Arabica Coffee:

8.1. *Soil Cultivation Experiment—Coffee Research Station:*

8.1.1. The different methods of soil cultivation employed in this experiment which was started in July 1954 on old Arabica coffee, are being continued. The yield data of the experiment are given in Table 'A'—I.

8.1.2. Neither the statistical analysis for the individual year 1960-61 nor the combined analysis over six years showed any significant result. The interaction of treatment into years was also found not significant. Considering the six years average yield, performance of different treatments, the treatment B (Trenching $\frac{3}{4}' \times \frac{3}{4}' \times 5'$ in May) has given numerically superior yield over other treatments.

8.1.3. With these results so far accumulated, it becomes evident that control (weeding only) might be an economical proposition because other treatments employed are time consuming, and more costly in relation to the resultant yield. Though in certain years an increase in yield of one or two hundredweights is obtained by certain treat-

ments over control, they cannot be relied upon for regular adoption as they are not statistically significant. Basing mainly on the yield figures it can be stated that under the present methods of cultivation, plant material used and environmental and edaphic conditions existing at Coffee Research Station, weeding only could be considered economical.

8.1.4. Assay of plant growth and available soil moisture in this experiment are being continued to be recorded from October 1960 onwards.

8.2. *Soil Management Experiment—Coffee Research Station:*

8.2.1. The soil management experiment was continued as reported earlier at the Coffee Research Station and the relevant yield data is given in Table 'A'—II.

8.2.2. The different treatments employed in this experiment did not give any significant result this year also. It may however be observed that during this year deep digging in April has given the highest yield.

8.2.3. A combined analysis of the data accumulated over a six years period ending 1960-61 was also undertaken. The analysis indicated that the error variance were all heterogeneous and there was no significant interaction between the treatments into years. The heterogeneity in the season 1955-56 and 1959-60 was particularly marked. Hence single degree of treatment comparisons were made between (D and F). (B and C), (D and G) and (D and C). Differences in the yield between treatments D and C was significant, whereas other treatment comparisons did not give any significant result. On perusal of the combined average yield figures, treatment D (light digging in November) appeared to be recording numerically higher yields during the six year period of experimentation.

9. Manurial Experiment on Robusta at Coffee Research Station:

9.1. The manurial trial on Robusta was continued and the yield data of the experiment are furnished in Table 'A'—III.

9.2. Statistical analysis of the yield data of this experiment has not given any significant results so far including the current year.

9.3. During 1957-58 and 1958-59 seasons, 80:30:40 (NPK per acre) gave numerically superior yield. In 1959-60 season 40:30:40(NPK per acre) gave the highest yield, while during the current season no manuring treatment gave the highest crop of 13.7 cwts/acre. 11.9 cwts and 9.6 cwts/acre were obtained from 80 N and 40 N respectively.

10. Robusta Manurial and Pruning Experiment—Bhadra Estate—Balehonnur:

10.1. This experiment was continued with no further modification.

10.2. The two levels of Nitrogen, *viz.*, 40 and 80 lb. to an acre were applied in two split equal doses during the pre-blossom and post-monsoon periods. The levels of Phosphoric acid and Potash at 30 and 40 lb. to the acre respectively were applied to all the

plots during post-monsoon season. 50% of the plant population was thinned out immediately after 1959-60 crop harvest uniformly in all the plots. The yield data of the experiment are given in Table 'A'—IV.

10.3. The experiment has not given any significant result so far including the current year.

10.4. This year highest yield was recorded (5.7 cwts/acre) in 80 lb. N to an acre treatment and the lowest (4.5 cwts/acre) in 40 N treatment. On the other hand no manuring was superior to 40 N, and pruning plus 40 N treatment. With these conflicting results no conclusion could be drawn from this experiment.

11. Experiment on the Influence of Topping on Growth and Yield of Robusta Coffee—Byregudda Estate—Balehonnur:

11.1. As detailed in the earlier reports the experiment was continued and the yield data are furnished in Table 'A'—V.

11.2. The yield differences between the two treatments employed were not statistically significant.

11.3. Out of the six years period of the experiment the first four years and the current season, recorded numerically higher yields for the plants topped at 4' height while during 1959-60 season the plants topped at 3' height gave numerically higher yield.

11.4. Since the coffee had closed in, in this experiment and the alternate numerical superiority of yield may be due to seasonal conditions and alternate bearing habit of the plant rather than induced by treatments. The experiment is concluded.

12. Mulching Trials on Young Arabica Coffee:

12.1. Two trials started during 1957 were continued.

12.2. *Mulching Experiment—Coffee Research Station:*

12.2.1. The experiment was continued with some green manure and cover crop as reported earlier. The yield data and growth measurements are furnished in Table 'A'—VI.

12.2.2. The yield responses due to different treatments did not show any significant result. However, mulching with cherry husk at 3 tons/acre and cover cropping with Calopogonium were numerically superior to the rest of the treatments including control. Further, the treatment with green manure before monsoon gave the lowest yield of 4.8 cwts/acre against 8.7 cwts/acre recorded under cherry husk mulching treatment. The growth measurement in terms of stem girth did not show any significant difference this year also.

Note: The establishment of Crotalaria anagyroides under shaded condition of the experimental plot was a complete failure during this season. After normal germination and emergence the young plants of Crotalaria died after exhibiting certain amount of wilting symptoms. The difficulty in establishing green manure plants under natural shade has already been reported by Shri S. Sundaram.

12.3. *Mulching-cum-Manurial Experiment—Coffee Research Station:*

12.3.1. As mulch material, cherry husk and dry leaves were procured and applied at 3 tons/acre in January 1961. The above mulch material could not be applied to the experimental plots in time due to certain local difficulties. The two levels of 20:30:40 and 40:30:40 NPK fertilisers were applied in two doses one pre-blossom and the other during post-monsoon period.

12.3.2. The yield data and growth measurement are given in Table 'A'—VII.

12.3.3. The analysis of yield and girth measurement data were not significant. During the current season cherry husk at 3 tons/acre along with 40:30:40 NPK manuring recorded the highest yield of 11.1 cwts/acre whereas manuring 20:30:40 NPK mixture per acre alone gave the lowest yield of 7.8 cwts/acre.

13. Studies on Crop Estimation:

13.1. The study was continued as detailed earlier with no further modifications. The estimates of crop based on the complete stripping technique are furnished in Table 'A'—VIII.

13.2. From the results once again, it was observed that the actuals were showing wide divergence from the estimated yield obtained by stripping technique.

13.3. From the experience gained during the past three seasons it is possible to infer that four plants selected at random are not adequate to represent the heterogeneous coffee population of an estate. Therefore it is contemplated to continue this experiment in detail at the two Research Stations only from 1961-62 onwards.

14. Brazilian System of Planting—Coffee Research Station:

14.1. The yield data obtained from this experiment are presented below:

Treatment—A—(Pits completely filled at the time of planting) gave an yield of 10 cwts/acre whereas Treatment—B—(Pits half filled at the time of planting) recorded 10.8.cwts/acre. The experiment is being continued.

15. Robusta Rehabilitation Trial—Coffee Research Station:

15.1. Except for regulation of shade clearing of trenches no other extra operations were undertaken. The rate of manuring was 80:60:80 NPK per acre and applied in three split doses. Other operations like weeding, suckering etc., were in conformity with the estate practices. The yield data collected from these blocks are given below:

Name of block	Yield of ripe cherry in lbs/acre	Yield of clean coffee in cwts/acre
1. Crawford area	3887	6.7 cwts
2. J-Block	3913	6.8 cwts

16. Intensive Cultivation Trial—Old Arabica—Coffee Research Station:

16.1. The intensive cultivation trial which was started during January 1960 was continued according to the schedule given in the 13th Annual Report. The block recorded an yield of 4.12 cwts/acre against 2.5 cwts/acre in the adjacent plots.

16.2. In all four sprayings and three doses of manuring were given according to programme. Insecticidal spray using Folidol E.605 was also applied along with pre-blossom Bordeaux spray. Two further rounds of Folidol were sprayed during May and June 1961 to control Thrips and to check their further build up.

16.3. As on July 1961 the blocks are comparatively free from leaf disease and A-normal growth symptoms associated with Thrips species. The crop on the bushes is fair. The trial and the observations are being continued.

17. Irrigation with Overhead Sprinkler—Coffee Research Station:

17.1. *Robusta:*

17.1.1. As already reported no experiment could be undertaken during 1959-60 season and mainly calibration work of the experiment was attended to. However, during first week of March 1960 a bulk plot of Robusta was irrigated by giving 1.5 inch of artificial rain to force the blossom. The flower buds responded well and the blossoms were quite satisfactory. The yield figures obtained from this plot and a non-sprinkled area are given below:

Irrigated 1st week March 1960 — 1 acre — 6.9 cwts

Control (natural blossom)
2nd week of March 1960 — 1 acre — 6.7 cwts

The irrigation could not give any appreciable difference in yield because of timely receipt of blossom showers which occurred during 2nd week of March 1960. Perhaps the interval of one week time from artificial irrigation to the natural blossom showers was not sufficient to induce any extra advantage for the irrigation treatment. It may be possible to conclude that artificial irrigation of Robusta to force out the blossom if employed during March period might give economical results in the years when normal blossom showers are received very late.

17.2. *Arabica:*

17.2.1. During January to March period of 1961 an observational trial was laid out to evaluate the response of artificial sprinkling at different months, levels of irrigation and split applications on blossom opening, fruit set, growth behaviour, incidence of pests and diseases and yield. The details of the experiment are given below:

Young Coffee—Treatments:

A. A_1 — 3″ of rain — January, February & March 1″ every month
A_2 — 4½″ ,, — ,, ,, ,, 1½″ ,,
A_3 — 6″ ,, — ,, ,, ,, 2″ ,,

B. B_1 — 1″ of rain — January 1″
B_2 — 1½″ ,, — ,, 1½″
B_3 — 2″ ,, — ,, 2″

C. C_1 — 1″ ,, — February 1″
C_2 — 1½″ ,, — ,, 1½″
C_3 — 2″ ,, — ,, 2″

D. D_1 — 1″ ,, — March 1″
D_2 — 1½″ ,, — ,, 1½″
D_3 — 2″ ,, — ,, 2″

E. E_1 — 2″ ,, — February & March 1″ each month
E_2 — 3″ ,, — ,, ,, 1½″ ,,
E_3 — 4″ ,, — ,, ,, 2″ ,,

F. F_1 — 3″ ,, — January 3″
F_2 — 4½″ ,, — ,, 4½″
F_3 — 6″ ,, — ,, 6″

G. Control — No irrigation.

H. H_1 — 2″ of rain — January 2″
H_2 — 3″ ,, — ,, 3″
H_2 — 4″ ,, — ,, 4″

Plot size 60′ × 180′ — Sub-plot — 60′ × 60′

Old Coffee (Arabica)—Treatments:

A. A_1 — 1″ given in February
A_2 — 1½″ ,, ,,
A_3 — 2″ ,, ,,

B. B_1 — 1″ ,, March
B_2 — 1½″ ,, ,,
B_3 — 2″ ,, ,,

C. C_1 — 2″ ,, February
C_2 — 3″ ,, ,,
C_3 — 4″ ,, ,,

D. D_1 — 2″ ,, ,, & March 1″ every month
D_2 — 3″ ,, ,, ,, 1½″ ,,
D_3 — 4″ ,, ,, ,, 2″ ,,

E. Control — No irrigation.

17.3. The preliminary observations revealed that irrigation over 3 inches either during January or February or March as one application appears to induce running and unsatisfactory blossoming. It may be of interest to note here that the blossoms started

opening from 7th day onwards and continued upto 14th day from the date of irrigation. On the other hand lower levels of irrigation and blossom opening under these treatments were quite satisfactory and appear to be uniform.

17.4. In all the cases of early irrigation, *i.e.*, during January and February, it induced fresh vegetative growth and in the case of leaf disease susceptible material fresh incidence of leaf disease was noticed on the new flush formed.

17.5. Under the treatments of low and high irrigation during January period the bud advancement and opening of the blossom appeared to be partial.

17.6. In the split application treatment of January and February sprinkling, partial flowering was noticed for the first dose of irrigation and again there was some response to the second irrigation after an interval of 30 days. This phenomenon might be due to the non-maturity of certain flower buds at the time of first irrigation to give necessary response to artificial rain applied.

17.7. In all the forced out blossoms high Thrips activity was noticed on the blossoms.

18. Studies on the Germination and Emergence of Coffee Seed—Coffee Research Station:

18.1. Experiments to evaluate the germination and emergence of seed in the germination beds subjected to different treatments were under study.

18.2. During this year different categories of seeds were sown as a bulk separately without any replications. The percentages of seed germination and emergence under different treatments are presented below.

18.3. *Methods of sowing seed coffee and their effect on germination:*

18.3.1. Seeds of Arabica and Robusta prepared during 1960 January were stored in different media in aluminium containers as detailed below:

Treatments:

A. Sun drying with parchment cover in tact, preserved in Sand.
B. Sun drying with parchment cover and preserved in Charcoal.
C. Sun drying with parchment cover and preserved in Ash.
D. Shade drying with parchment cover and preserved in Sand.
E. Shade drying with parchment cover and preserved in Charcoal.
F. Shade drying with parchment cover and preserved in Ash.
G. Shade drying with parchment cover and treated with Agroson.
H. Sun drying with parchment cover and treated with Agroson.
I. Shade drying with parchment—Control.
J. Sun drying with parchment—Control.

18.3.2. Under each method of storage treatments, four identical samples were prepared and tins were sealed using paraffin wax. The seeds thus stored were sown from November 1960 onwards at monthly intervals upto February 1961.

18.3.3. The seeds stored for almost 9 to 12 months employing different inert material did not germinate in any of the monthly sowings undertaken after the period of storage.

18.4. *Germination of Arabica and Robusta seeds as influenced by time of sowing:*

18.4.1. Seeds of Arabica and Robusta were prepared in the usual manner and dried under shade to a constant moisture level. Monthly sowings of Arabica were undertaken from January 1961 to April 1961 period. January sowing gave the highest percentage of germination and emergence (96%) and there was progressive decline in the February to April sowings. And the April sowing recorded 54% germination only.

18.4.2. In a similar manner Robusta sowings were carried out from February to April 1961 period at monthly intervals. In the case of Robusta 88%, 66% and 43% germination were recorded for the sowings in February, March and April 1961 respectively. The same trends were also noticed in the previous years. The seedlings obtained from different monthly sowings were transplanted into polythene bags, bamboo baskets and secondary beds to evaluate the rate of growth upto transplanting into the field, were also undertaken. Further observations are in progress.

18.5. *Bamboo baskets Vs Polythene bags:*

18.5.1. Arabica and Robusta seedlings were transplanted into bamboo baskets, transparent polythene bags and black polythene bags to evaluate the growth performance of the seedlings.

18.5.2. This experiment was laid out as a randomised replicated trial and further observations are in progress.

18.6. *Hormone studies:*

18.6.1. A preliminary study to find out the effect of different hormones on the emergence of Arabica seed coffee was undertaken during the sowing season in 1960. The seedlings obtained from different treatments were transplanted to the secondary beds. These seedlings received two applications of follow up hormone treatments. Growth record in terms of height of the plants in centimetres, number of leaves formed, fresh weight of leaves, stem and root were recorded during the end of April 1961, and the data pertaining to the height of the plant are given in Table 'A'—IX.

18.6.2. Of all the growth characteristics analysed, the stem height in centimetres recorded in April 1961 gave significant result at 5% level due to the treatments employed.

18.6.3. Treatment G was significantly superior to the treatments D, C and L. However, there was no considerable significance among other hormone treatments including G. On the whole most of the hormones employed have not given any effect to increase the linear growth of the coffee seedlings over control. With this finding it may be concluded that different types of hormones used in this experimentation can be considered not useful to increase the growth of coffee seedlings.

19. Die-back Project:

19.1. *Physiological approach:*

19.1.1. Work on the Result Demonstration Blocks were carried out as far as

possible and practicable according to programmed schedule. The yield figures obtained from these blocks are as follows:

	Name of the Estate	Area of R.D.B and yield			Area of control block and yield			Yield/acre R.D.B.	Control
			Ton	Cwts.		Tons	Cwts.	Cwts.	Cwts.
1	Koodnahalli Estate	5 ac	1	8	5 ac	0	13.3	5.6	2.66
2	Dodlakunda Estate	5 ac	2	10	6 ac	1	19.0	10.0	6.5
3	Sulugode Estate	5 ac	1	17	5 ac	1	16½	7.4	7.3
4	Wartyhally Estate	6 ac	2	7	9 ac	3	10	7.8	7.7
5	Kithlamane Estate	5 ac	1	11¼	5 ac	1	8-1/8	6.25	5.60
6	Cheekanahally Estate	3 ac	0	11	3 ac	0	11.3	3.66	3.76
7	Chikly Estate	5 ac	1	2	5 ac	1	0.5	4.4	4.1

19.1.2. Visual observations recorded so far are presented below:

19.1.2.1. The 0.5% neutral Bordeaux mixture spray, sprayed according to programme in most of the blocks, controlled leaf disease incidence effectively upto September 1960. The post-September flush showed certain amount of leaf disease before November spray was taken up. It was also noticed that post-November flush showed leaf disease incidence and on examination of leaves it was found that certain species of Thrips were involved in the dispersal of leaf disease spores on the new and young flush as and when they were forming and expanding.

19.1.2.2. From the above observations it was clear that an insecticidal spray if given during post-monsoon period, to control Thrips, might minimise leaf disease incidence.

19.1.2.3. The detailed observations were already published in January and March 1961 issues of *Indian Coffee*.

19.1.2.4. The A-normal growth of post-September flush was mild to severe in different blocks. However, a definite association of A-normal growth with Thrips incidence was noticed.

19.1.2.5. In general defoliation due to leaf disease incidence was at its minimum in these blocks. The leaf complement in these blocks were quite satisfactory when compared to the check plots.

19.1.2.6. Almost all the blocks recorded yield ranging from 4 to 10 cwts/acre. In spite of the heavy crop borne by the bushes in these trial blocks, the plants did not show any sign of exhaustion or resultant regular die-back.

19.1.2.7. At the moment of writing this report almost all the blocks situated in different estates were quite healthy. However, the present healthy condition might perhaps be largely attributable to the insecticidal sprays employed during pre-blossom and pre-monsoon periods. The crop in all these blocks appears to be above average and incidentally the Thrips build up appears to be less.

19.2. *Malformations and virus-like symptoms:*

19.2.1. As reported earlier the successful grafts under observation did not show any indication of the disease symptoms and transmission from the affected scion to stock so far. Further observations are in progress.

19.3. *Field observations:*

19.3.1. Observations made from post-September period definitely revealed a correlation of shade intensity and population of different instars of thrips. Less shade encourages high incidence of thrips and in turn severe intensity of A-normal growth of leaves.

19.3.2. Wherever an insecticidal spray has been undertaken to control the thrips during and after September period the symptoms associated with new malady were not apparent.

19.3.3. A detailed survey was undertaken to evaluate the post-harvest, pre-blossom and post-blossom die-back. A separate report entitled, "Report on the Survey of New Malady Affecting Coffee in South India" was prepared and is being published elsewhere.

20. Phytotoxic Studies with BHC:

20.1. Different experiments were undertaken to evaluate the phytotoxic effects of BHC on coffee. The following is the summary of the findings emanated from these experiments.

20.1.1. Symptoms similar to pith discolouration noticed in *Coffea Arabica* was artificially induced by dipping cut twigs in different concentrations of BHC.

20.1.2. The seedlings (1½ years old) treated with BHC suspensions during November 1960 showed distinct interveinal chlorosis of leaves formed during March 1961. Further due to this treatment there was a general stunting of linear growth of seedlings when compared with untreated control seedlings.

20.1.3. Similarly treatment of germination beds with BHC 50% W.P. affected normal emergence of seedlings. On examination all the seedlings showed stunting of roots, club shaped in appearance and with sparse or no lateral roots. Such type of seedlings when transplanted to untreated soil were found to strike normal but somewhat bunchy type of root system. The methods employed in this experiment, materials used in this and the details of observations made are published in June-July 1961 issue of *Indian Coffee.*

20.1.4. In collaboration with the Central Food Technological Research Institute, the possible translocation of BHC from treated to untreated parts of the coffee plants are under study.

20.2. From the preliminary estimations, indications were obtained that BHC applied to stem regularly could be detected in the untreated coffee twigs and fruits.

20.3. Further studies are in progress.

21. Weedicide Trials:

21.1. Experiments using Dowpon with different concentrations and time of application were laid out at the Coffee Research Station, Coffee Research Sub-Station and three other Liaison Districts. The treatments were as follows:

A — 5 lb. of Dowpon in 200 gallons per acre—pre-monsoon application.

B — 10 lb. of Dowpon in 200 gallons per acre—pre-monsoon application.

C — 5 lb. of Dowpon in 200 gallons per acre—split doses—half the quantity in pre-monsoon and the balance in August break in the monsoon.

D — 10 lb. of Dowpon in 200 gallons per acre—split doses—half the quantity in pre-monsoon and the balance in August break in the monsoon.

E — 5 lb. of Dowpon in 200 gallons per acre—applied during break in the monsoon—August.

F — 10 lb. of Dowpon in 200 gallons per acre—applied during the break in the monsoon—August.

G — No application—control—estate practice.

21.2. The above quantities were dissolved in 200 gallons of water and applied uniformly as spray using available Knapsack sprayers with fine jets according to the time schedule given under various treatments.

21.3. The consolidated observations made in different localities on this experiment are given below:

(i) *Effect of the chemical on coffee:* In all the concentrations used phytotoxic effect on coffee was not seen.

(ii) *Effect of the chemical on other weeds:* The chemical has no effect on any of the common soft weeds found in coffee plantations.

(iii) *Effect of the chemical on grass:*

(a) *Low strength:* ($2\frac{1}{2}$ and 5 lb./acre)

Pre-monsoon application: The effect on grass was not satisfactory though superficial scorching was noticed to some extent. The regeneration of grass and its growth was noticed from post-September period onwards in these plots.

Post-monsoon application: Here again the grass kill was not satisfactory under $2\frac{1}{2}$ lb. doses per acre and one or two months after application of this chemical re-growth of grass was noticed. However, 5 lb. per acre dose during this period gave comparatively better grass kill than pre-monsoon application of this dose.

(b) *Higher strength:* (10 lb./acre)

Pre-monsoon application: In the case of the treatments under 10 lb. per acre Dowpon, there was satisfactory kill of grass one month

after application of the chemical. Re-generation of grass growth was noticed after 4 to 6 months duration from the date of imposition of treatment.

Post-monsoon application: Plots receiving 10 lb. dose during post-monsoon period showed death of grass to an appreciable extent. Once again in these plots re-generation of grass was noticed after 4 to 6 months interval.

(iv) Split application of 5 lb. did not give satisfactory kill of grass. However, split application of 10 lb. kept the plots free of grass for longer duration which encouraged succulent type of weed growth in abundance.

(v) *Effect of chemical on dadaps:*

(a) 2½ lb./acre Dowpon application did not affect young dadaps and they did not show any phytotoxic symptoms throughout the period of observation.

(b) In the case of concentrations of 5 and 10 lbs./acre phytotoxic effects on dadaps were noticed one to two months after treatment. Young dadaps in these plots defoliated partially in the case of 5 lb. concentration and almost completely under 10 lb. concentration. Further, fresh growth of shoots of dadaps were not at all normal. The fresh leaves produced were rough, leathery, brittle with bunchy proliferations. In plot where dadaps were left unlopped terminal branch death was also noticed.

(c) In general Dowpon application appears to affect dadaps whether applied after lopping or applied and left unlopped. However, the phytotoxic effect appears to be more pronounced on lopped dadaps. Because of this defoliation of dadaps, coffee under them appears to suffer very much due to exposure during the hot weather period. This open condition once again appears to encourage luxuriant soft weed growth.

21.4. *Comments:*

21.4.1. From the above observations it is evident that for successful results, the grass must be growing actively and there must be sufficient foliage or leaf blade area to absorb the chemical.

21.4.2. 10 lb./acre concentration appears to give quick seasonal control whereas split application at the rate of 5 lb./acre keeps the field free of grass for longer duration.

21.4.3. The dadap trees showed pronounced phytotoxic symptoms during September to November period though treated during preceding May-June or August-September. Thus under the prevailing conditions in coffee plantations the persistence of Dowpon can be anywhere between 6 to 12 months.

21.4.4. In the treated plots a period of 12 to 24 months is needed for the dadaps to regain normal shape, though in very few cases death of young dadaps occurred.

21.4.5. However, these trials have to be repeated to ascertain and to correlate the age of dadap trees and degree of phytotoxic symptoms exhibited due to this chemical.

21.5. Another experiment was started at Coffee Research Station to evaluate the effect of a proprietary weedicide sold under the name of 'Isocornox' (4-Chloro-2-Methyl Phenoxy Propionic acid—Potassium salt) supplied by M/s. Boots Pure Drug Co., Bombay. The chemical applied to an open weedy patch of the estate during post-monsoon period of 1960 did not give any control of common soft and grass weeds present in the experimental plots. The chemical was applied as spray application at the recommended dose of 8 pints in 100 gallons/acre. Further to evaluate the efficacy of the chemical another trial was laid out in a weedy plot under young coffee during May 1961. No weed kill occurred in these plots for the concentration employed. Further observations are in progress.

22. Soil Cultivation Experiment—Coffee Research Sub-Station, Chethalli:

22.1. This experiment which was started in the year 1953 was continued. Different methods of soil cultivation such as trenching, renovation pitting, light and deep digging during October-November period are under comparison against control (weeding only). The yield data of the experiment are given in Table 'A'—X.

22.2. The yield differences for the past seven years were not significant. During 1959-60 the treatments employed gave significant results at 5% level. The treatments, light digging and renovation pitting were significantly superior to the rest of the treatments including control. However, during this season difference in the yield of coffee due to different types of soil cultivation practices were not significant. Light digging in November gave numerically superior yield.

23. Coffee Demonstration Farms:

23.1. Spacing, varietal and manurial experiments in different regions were started at the existing Coffee Demonstration Farms. The details of the experiments are as follows:—

A. *Manurial Experiment:* Coffee Demonstration Farms. Started during 1960-61 season.

Treatments:

(a) *Levels of N.P.K.* (Main treatment)

(i) 60:30:40
(ii) 100:60:80
(iii) 140:90:120
(iv) 180:120:160
(v) 220:150:200

(b) *Number of applications:* (Sub-treatment)

(i) Twice in a year (Pre-monsoon and post-monsoon)

(ii) Three applications in a year (Pre-blossom, pre-monsoon and post-monsoon)

(iii) Four applications in a year (Pre-blossom, pre-monsoon, monsoon breaks and post-monsoon)

Treatment combinations—5×3—15

Total number of main plots—20

Total number of sub-plots—60

Spacing—7′×7′

Area under experiment—3 acres (approx.)

Main plot—126′×42′

Sub-plot—42′×42′

Replications—4

Observations on general growth and yield are being recorded.

B. *Varietal Trial:* Started during 1960.

Treatments:

(i) S. 795—A

(ii) Kents —B

(iii) S. 645—C

(iv) S. 12—D

(v) S. 881—E

Replications: 5

Area: 308′×191.75′

Observations on growth and performance of these varieties are in progress.

C. *Spacing Trial:* Started during 1960.

Treatments:

	1st stage	2nd stage	Final stage
A	3′ × 3′	3′ × 6′	6′ × 6′
B	4′ × 4′	4′ × 8′	8′ × 8′
C	6′ × 3′	6′ × 6′	12′ × 6′
D	6′ × 4′	6′ × 8′	12′ × 8′
E	6′ × 6′	6′ × 12′	12′ × 12′
F	6′ × 9′	*6′ × 18′	*12′ × 18′

* *Note:* Depending on the growth the final stage will be determined.

Design: Randomised block

Replications: 6

Variety used: S.795

Area: 2 acres (approx.)

Size of Experimental Field: 324′×264′ (including roads and paths)

Size of Gross Plot: 48′×36′

Observations on growth and general spread of the bushes are in progress.

D. *Simple Manurial Trials:* Selected Estates in Liaison Districts (48 Estates). Started during 1961.

Treatments:

A	—	NPK	60:30:40	per acre in	3 or 4 doses.
B	—	N only	60 lb.	,,	,,
C	—	NP	60:30	,,	,,
D	—	NK	60:40	,,	,,
E	—	Estate practice — control.			

Area of the experiment: 2 acres.

Area of each plot: ½ acre.

Observations are in progress.

K. C. ANANTH,
Agronomist

TABLE 'A' — I

SOIL CULTIVATION EXPERIMENT

Locality: Coffee Research Station, Balehonnur
Design: Randomized Blocks
Treatments: Six
Plot Size: $4 \times 20 = 80$ plants (4.5 cents)
Total Area under Experiment: 1.08 acres

Year of commencement: 1954-55
Replications: Four
Variety: Coorgs Arabica
Age: 30 years
Spacing: 5′ × 5′

Sl. No.	TREATMENTS	Mean yield of calculated ripe cherry in lb. per acre				Mean yield of calculated clean coffee in cwt. per acre			
		1954–55 Basic	Average for 5 years	1960–61	Average for 6 years	1954–55 Basic	Average for 5 years	1960–61	Average for 6 years
A	Trenching 1½′ × ¾′ × 5′	3,204	3,184	2,542	3,077	5.27	4.84	3.78	4.66
B	Trenching ¾′ × ¾′ × 5′	4,092	3,414	3,267	3,390	6.85	5.15	4.86	5.10
C	Renovation pittings 1½′ × ¾′ × 3′	3,673	3,257	2,716	3,167	5.95	4.99	4.04	4.83
D	Deep digging—November	3,872	3,064	2,593	2,985	6.05	4.69	3.85	4.55
E	Light digging—November	3,855	3,023	2,788	2,984	6.56	4.60	4.14	4.52
F	Control (weeding only)	3,873	2,091	2,744	2,875	6.38	4.39	4.08	4.34
	General Mean	3,762	3,140	2,775	3,079	6.18	4.77	4.12	4.66
	S.E.M.	588.7	—	459.5	—	—	—	—	—
	Significance	Basic	—	No	—	—	—	—	—

TABLE 'A' — II

SOIL MANAGEMENT EXPERIMENT

Locality: Coffee Research Station, Balehonnur
Design: Randomized Blocks
Treatments: Seven
Plot Size: 5 × 16 = 80 plants (4.5 cents)
Age: Over 30 years

Year of commencement: 1954-55
Replications: Four
Variety: Coorgs Arabica
Area under Experiment: 1.2 acres
Spacing: 5′ × 5′

Sl. No.	TREATMENTS	Mean yield of calculated ripe cherry in lb. per acre				Mean yield of calculated clean coffee in cwt. per acre			
		1954-55 Basic	Average yield for 5 years	1960-61	Average yield for 6 years	1954-55 Basic	Average yield for 5 years	1960-61	Average yield for 6 years
A	Deep digging—August	6,698	3,356	2,871	3,275	10.65	5.14	4.27	4.99
B	Light digging—August	6,175	3,665	2,786	3,518	10.34	5.44	4.10	5.21
C	Deep digging—November	4,949	3,582	2,707	3,437	8.01	5.43	4.02	5.20
D	Light digging—November	5,842	3,737	3,033	3,619	9.78	5.64	4.51	5.45
E	Deep digging—April	5,543	3,532	3,147	3,468	9.12	5.21	4.68	5.12
F	Scuffling—April	4,451	3,256	2,741	3,171	6.96	5.40	4.07	4.87
G	Control (weeding only)	6,151	3,355	2,349	3,188	9.96	5.08	3.47	4.81
	General Mean	5,687	3,497	2,805	3,382	9.26	5.28	4.17	5.09
	S.E.M.	540.7	—	386.8	—	—	—	—	—
	Significance	Basic	—	No	—	—	—	—	—

TABLE 'A' — III

MANURIAL EXPERIMENT ON ROBUSTA

Locality: Coffee Research Station, Balehonnur

Year of commencement: 1951-52

Design: Randomized Blocks

Replications: Six

Treatments: Three

Plot Size: Gross—4 × 8 = 32 plants

Total Area under Experiment: 0.85 acres

Net—2 × 6 = 12 plants

Sl. No.	TREATMENTS	Calculated mean yield of ripe cherry in lb. per acre				Calculated mean yield of clean coffee in cwt. per acre			
		1951–52 Basic	Average yield for 8 years	1960–61	Average yield for 9 years	1951–52 Basic	Average yield for 8 years	1960–61	Average yield for 9 years
A	Manured at NPK 40:30:40	1,793	3,046	5,322	3,299	3.02	5.54	9.50	5.98
B	Manured at NPK 80:30:40	1,804	3,166	6,702	3,559	3.27	5.75	11.96	6.44
C	Control—No manure	1,331	3,000	7,581	3,509	2.44	5.35	13.53	6.25
	General Mean	1,625	3,077	6,535	3,456	2.91	5.55	11.66	6.22
	S.E.M.	—	—	1.97	—	—	—	—	—
	Significance	Basic	—	No	—	Basic	—	No	—

TABLE 'A' — IV

ROBUSTA MANURIAL AND PRUNING EXPERIMENT

Locality: Bhadra Estate, Balehonnur

Year of commencement: 1952-53

Design: Latin Square

Replications: Six

Treatments: Six

Total Area under Experiment: 3.17 acres

Plot Size: Gross—6 × 10 = 60 plants (8.8 cents)

Net—4 × 8 = 32 plants (4.7 cents)

Sl. No.	TREATMENTS	Calculated mean yield of ripe cherry in lb. per acre				Calculated mean yield of clean coffee in cwt. per acre			
		1952–53 Basic	Average for 7 years	1960–61	Average for 8 years	1952–53 Basic	Average for 7 years	1960–61	Average for 8 years
A	Control (no manure)	3,836	3,980	2,829	3,836	6.80	6.92	5.05	6.69
B	Pruned (no manure)	3,586	4,086	3,084	3,960	6.31	7.20	5.50	6.99
C	Manured—NPK at 40:30:40	3,707	4,244	2,531	4,030	6.48	7.56	4.52	7.18
D	Manured—NPK at 80:30:40	4,038	4,349	3,187	4,204	7.10	7.65	5.69	7.40
E	Manured—NPK at 40:30:40 **plus** pruned	4,265	4,508	2,740	4,287	7.49	8.34	4.89	7.90
F	Manured—NPK at 80:30:40 **plus** pruned	3,925	4,474	3,155	4,309	6.79	8.23	5.63	7.90
	General Mean	3,893	4,274	2,921	4,104	6.81	7.65	5.21	7.35
	S.E.M.	693.7	—	902.10	—	—	—	—	—
	Significance	Basic	—	No	—	—	—	—	—

TABLE 'A' — V

ROBUSTA TOPPING EXPERIMENT

Locality: Byregudda Estate, Balehonnur

Year of commencement: 1951-52

Design: AB BA Pattern

Plot Size: 4 × 8 = 32 plants

Treatments: Two

Spacing: 9′ × 9′

Replications: Twelve

Sl. No.	TREATMENTS	Mean stem girth measurement in cm.			Calculated mean yield of ripe cherry in lb. per acre			
		1955–56	1956–57	1957–58	1955–56 Basic	Average for 5 years	1960–61	Average for 6 years
A	Topped at 3 ft. height	5.75	6.58	6.95	469	983	5,919	1,806
B	Topped at 4 ft. height	5.64	6.41	6.77	668	1,103	6,853	2,061
	General Mean	5.69	6.50	6.86	568	1,043	6,386	1,933
	S.E.M.	—	—	0.25	77.7	—	1449.74	—
	Significance	—	—	No	No	—	No	—

TABLE 'A' — VI

MULCHING EXPERIMENT

Locality: Coffee Research Station, Balehonnur
Design: Randomized Blocks
Treatments: Six
Replications: Four

Year of commencement: 1956-57
Variety: Arabica Selection
Total Area under Experiment: 0.68 acres
Plot Size: Gross—35 plants (2.89 cents)
Net—15 plants (1.24 cents)

Sl. No.	TREATMENTS	Mean stem girth measurement in cm.						Yield of ripe cherry in lb. per acre		
		1957	1958	1959	1960	1961	Increase over previous year	1957–58 Basic	1958–59	1959–60	1960–61
A	Control (no mulch)	1.5	2.1	3.2	3.7	4.34	0.64	61	828	2,302	3,405
B	Mulching with dry leaves at 3 tons per acre	1.4	2.0	3.2	3.3	4.12	1.03	68	667	3,063	4,147
C	Mulching with cherry husk at 3 tons per acre	1.7	2.4	3.5	3.5	4.41	0.98	95	1,461	2,465	5,859
D	Cover cropping	1.5	2.2	3.0	3.2	4.37	1.15	174	1,195	2,341	5,752
E	Green manure before monsoon	1.3	2.1	3.0	3.5	4.29	0.84	118	907	2,107	3,403
F	Green manure after monsoon	1.3	2.0	2.8	3.1	4.37	1.29	47	682	2,471	3,655
	General Mean	1.4	2.1	3.1	3.4	4.32	0.99	94	957	2,458	4,370
	S.E.M.	0.34	0.49	0.67	1.08	0.38	1.48	29.5	302.8	408.4	1,265.6
	Significance	Basic	No	No	No	No	No	Basic	No	No	No

TABLE 'A' — VII

MULCHING-CUM-MANURIAL EXPERIMENT

Locality: Coffee Research Station, Balehonnur
Design: Randomized Blocks
Treatments: Six
Replications: Four

Year of commencement: 1956-57
Variety: Arabica Selection
Total Area under Experiment: 0.68 acres
Plot Size: Gross—35 plants (2.89 cents)
Net—15 plants (1.24 cents)

Sl. No.	TREATMENTS	Mean stem girth measurement in cm.						Calculated mean yield of ripe cherry in lb. per acre			
		1957	1958	1959	1960	1961	Increase over previous year	1957–58	1958–1959	1959–60	1960–61
A	Manured NPK at 20:30:40	1.4	2.3	3.3	3.9	4.5	0.59	393	2,193	2,308	5,254
B	Manured NPK at 40:30:40	1.2	2.1	3.3	3.7	4.2	0.52	197	1,886	3,063	5,396
C	Manured as in A plus dry leaf mulch at 3 tons/acre	1.4	2.5	3.5	3.9	4.4	0.75	690	4,047	2,465	6,856
D	Manured as in B plus dry leaf mulch at 3 tons/acre	1.3	2.4	3.4	3.8	4.1	0.52	742	2,361	1,873	5,678
E	Manured as in A plus cherry husk mulch at 3 tons/acre	1.5	2.4	3.4	3.9	4.5	0.58	371	3,071	2,109	6,599
F	Manured as in B plus cherry husk mulch at 3 tons/acre	1.4	2.4	3.5	4.1	4.1	0.32	358	2,117	2,471	7,449
	General Mean	1.3	2.4	3.4	3.9	4.3	0.55	458	2,613	2,382	6,205
	S.E.M.	0.34	0.48	0.58	0.58	0.24	—	245.7	816.5	483.4	869.41
	Significance	Basic	No	No	No	No	—	Basic	No	No	No

TABLE 'A' — VIII

CROP ESTIMATION STUDIES — KENYAN PRE-HARVEST STRIPPING METHOD

Liaison District— Estate Selected	1958–59 (Estimates in tons)					1959–60 (Estimates in tons)					1960–61 (Estimates in tons)				
	I Stripping	II Stripping	Actual crop picked in tons	%age of over or underestimate I or II stripping		I Stripping	II Stripping	Actual crop picked in tons	%age of over or underestimate I or II stripping		I Stripping	II Stripping	Actual crop picked in tons	%age of over or underestimate I or II stripping	
1 Somwarpet:															
(1) Masgode	8.6	6.3	9.50	— 9.47	I	5.0	6.75	7.5	— 10.0	II	6.43	9.1	11.5	— 20.9	II
(2) Madegode	2.6	4.4	5.25	— 16.30	II	7.0	9.65	10.0	— 3.5	II	9.05	9.4	9.5	— 1.05	II
(3) Kibbetta	3.4	2.3	3.75	— 9.31	I	—	—	—	—		—	—	—	—	
2 Gonicoppal:															
(1) Alitopoo	10.3	10.7	30.00	— 64.3	II	70.7	69.60	56.1	+ 24.0	II	56.75	52.6	N.A.	—	
(2) Athithope	3.1	3.7	7.50	— 50.6	II	4.15	3.57	4.5	— 7.8	I	10.25	11.6	N.A.	—	
(3) Balmanay	13.8	14.0	24.67	— 43.3	II	27.40	27.90	26.00	+ 5.4	I	45.30	57.4	N.A.	—	
(4) Kondamuri	41.4	54.9	23.90	+ 42.2	I	18.55	15.10	14.45	+ 4.5	II	48.70	41.0	N.A.	—	
(5) Yemmegundi	50.1	49.9	125.00	— 59.8	I	40.00	37.05	32.05	+ 15.6	II	206.25	222.0	N.A.	—	
(6) Hoovinakadu	62.7	65.9	132.50	— 50.3	II	179.21	147.40	140.00	+ 5.3	II	138.00	169.00	N.A.	—	
3 Mudigere:															
(1) Javali	8.5	6.6	11.55	— 26.41	I	14.60	15.35	17.00	— 9.7	II	12.45	14.00	13.5	+ 3.7	II
(2) Heggudlu	70.6	66.9	19.20	+248.4	II	15.45	10.75	13.00	— 17.3	II	38.60	50.40	54.00	— 6.6	II
4 Saklespur:															
(1) Goorgully	36.8	54.0	34.00	+ 7.6	I	33.35	40.30	24.10	+ 39.0	I	23.90	24.75	23.25	+ 2.7	I
(2) Kendanamane	7.1	8.7	5.50	+ 22.5	I	6.60	8.15	5.50	+ 20.0	I	18.75	25.75	20.00	— 6.25	I
(3) Sulugode	32.2	28.7	31.00	+ 3.7	I	15.50	22.10	33.75	— 34.5	II	54.20	59.75	51.00	+ 6.3	I
(4) Biccode	44.4	34.2	20.00	+ 71.0	II	88.00	138.20	104.68	— 16.0	I	50.00	37.50	49.00	+ 2.0	I
(5) Doddalakunda	36.0	52.6	47.00	+ 11.9	II	19.00	18.15	35.00	— 48.1	II	86.35	45.75	72.00	+ 19.9	I

TABLE 'A' — VIII (Contd.)

Liaison District— Estate Selected	1958–59 (Estimates in tons)					1959–60 (Estimates in tons)					1960–61 (Estimates in tons)				
	I Stripping	II Stripping	Actual crop picked in tons	%age of over or underestimate I or II stripping		I Stripping	II Stripping	Actual crop picked in tons	%age of over or underestimate I or II stripping		I Stripping	II Stripping	Actual crop picked in tons	%age of over or underestimate I or II stripping	
5 Chikmagalur:															
(1) Vasantcool	16.7	16.0	18.00	— 7.2	I	11.00	24.60	20.30	+ 21.0	II	16.75	36.00	48.00	— 25.0	II
(2) Chandragiri	23.4	40.7	19.75	+ 15.6	I	30.75	19.35	23.00	— 15.8	II	44.80	63.10	55.00	— 18.5	I
(3) Shivagiri	3.7	1.7	1.75	— 2.86	II	—	—	—	—		—	—	—	—	
(4) Gowrishanker	5.9	5.5	4.75	+ 13.6	II	—	—	—	—		—	—	—	—	
6 Nilgiris:															
(1) Athigundu	4.6	4.6	7.00	— 34.28	II	13.85	11.65	14.00	— 1.0	I	1.60	3.85	2.00	— 20.0	I
(2) Benhope	2.5	3.4	3.50	— 2.8	II	9.70	14.75	13.80	+ 7.0	II	3.85	3.75	9.75	— 60.5	I
(3) Mailoor	4.6	7.8	5.50	— 16.36	I	5.70	6.15	4.27	+ 33.5	I	—	—	—	—	
(4) Glenburn	16.6	8.9	15.25	+ 8.8	I	34.50	37.60	35.00	— 1.4	I	9.80	9.20	15.00	— 34.6	I
7 Kottayam:															
(1) Thaliar	—	—	—	—		10.50	—	10.00	+ 5.0	I	46.80	—	60.00	— 22.0	I
8 Kalpetta:															
(1) Porkady	7.3	10.4	8.70	— 16.0	I	7.25	4.75	4.90	— 3.0	II	7.95	7.30	8.4	— 0.5	II
(2) Padripara	25.9	27.0	24.70	+ 4.6	I	17.00	17.85	15.93	+ 6.6	I	26.90	26.75	23.9	+ 12.0	II
(3) Puliyaramala	29.4	17.4	23.40	+ 20.4	I	17.60	18.45	12.37	+ 42.3	I	29.90	26.60	22.0	+ 21.0	II
(4) North Carolina	17.9	18.0	28.9	— 37.7	II	7.75	7.00	5.27	+ 32.8	II	15.15	18.25	15.0	+ 1.0	I
(5) Puthuthottam	6.9	13.6	12.31	+ 9.4	II	8.90	7.20	7.75	— 7.0	II	10.90	17.60	7.5	+ 45.30	I

TABLE 'A' — VIII (Contd.)

Liaison District— Estate Selected	1958–59 (Estimates in tons)					1959–60 (Estimates in tons)					1960–61 (Estimates in tons)				
	I Stripping	II Stripping	Actual crop picked in tons	%age of over or underestimate I or II stripping		I Stripping	II Stripping	Actual crop picked in tons	%age of over or underestimate I or II stripping		I Stripping	II Stripping	Actual crop picked in tons	%age of over or underestimate I or II stripping	
9 Pulneys:															
(1) Kanalkadoo	52.4	—	15.00	+249.13	I	—	—	—	—		2.90	4.10	5.85	— 29.9	II
(2) Periavalai	1.2	—	1.25	— 0.8	I	—	—	—	—		—	—	—	—	
(3) Nizhalkapi	1.0	—	1.33	— 21.81	I	—	—	—	—		1.60	1.65	1.86	— 11.2	II
(4) Rothaikadoo	11.2 Cwt.	—	10.00	+ 10.7	I	—	—	—	—		—	—	—	—	
(5) Periamalai	17.2 „	—	3.13	— 72.53	I	—	—	—	—		—	—	—	—	
(6) Karupiah	—	—	—	—		—	—	—	—		2.0	1.50	6.85	— 70.0	I
10 Yercaud: (Shevaroys)															
(1) Arcadia	6.1	13.6	16.66	— 24.3	II	—	—	—	—		16.1	14.1	20.00	— 19.5	I
(2) Cainton	1.0	1.5	1.43	+ 4.6	II	—	—	—	—		2.55	1.75	4.75	— 46.4	I
(3) Mundakambadi	—	—	—	—		—	—	—	—		5.05	4.50	N.A.	—	
(4) Chencaud	—	—	—	—		—	—	—	—		61.60	35.80	61.00	+ 0.99	I
(5) Moulvi	—	—	—	—		—	—	—	—		16.80	8.80	18.00	— 6.66	I
I. Coffee Research Stn. Balehonnur	22.9	20.1	19.93	+ 0.8	II	10.57	10.75	9.25	+ 10.4	I	29.00	27.08	25.27	+ 6.6	II
II. Coffee Research Sub-Stn. Chethalli	21.6	22.1	25.00	— 11.53	II	14.60	18.55	28.60	— 35.1	II	48.75	36.60	53.57	— 8.9	I

N.A. = Not available; (+) Overestimate; (—) Underestimate.

TABLE 'A' — IX

HORMONE STUDIES — ARABICA

April 1961

	Treatments		Mean height in centimetre
A —	Naphthalene acetic acid	— 25 ppm.	43.3
B —	Naphthalene acetic acid	— 50 ppm.	42.9
C —	-do-	— 100 ppm.	29.9
D —	Indolyl acetic acid	— 25 ppm.	33.1
E —	-do-	— 50 ppm.	36.6
F —	-do-	— 100 ppm.	39.2
G —	Indolyl butyric acid	— 25 ppm.	45.9
H —	-do-	— 50 ppm.	38.1
I —	-do-	— 100 ppm.	39.0
J —	Trichlorophenoxy— propionic acid	— 25 ppm.	35.3
K —	-do-	— 50 ppm.	37.8
L —	-do-	— 100 ppm.	28.3
M —	Soaked in water with parchment cover		40.9
N —	Soaked in water without parchment cover		40.6
O —	No treatment—without parchment cover		41.9
P —	No treatment—with parchment cover		36.7
	General Mean		37.9
	S.E.M.		223.65
	Significance		Yes
	Critical Difference		11.48
	Conclusion		G A B O M N F I H K P E J D C L

TABLE 'A' — IX (a)

HORMONE STUDIES — ARABICA

April 1961

Treatments	Mean No. of leaves on the main stem	Mean fresh weight of		
		Root in g.	Stem in g.	Shoot in g.
A — Naphthalene acetic acid — 25 ppm.	6.8	12.05	13.50	58.35
B — -do- — 50 ppm.	5.3	9.20	10.50	41.35
C — -do- — 100 ppm.	7.8	8.25	8.05	33.45
D — Indolyl butyric acid — 25 ppm.	6.2	5.70	6.90	21.95
E — -do- — 50 ppm.	6.5	9.55	10.40	42.25
F — -do- — 100 ppm.	5.8	8.25	8.15	42.35
G — Indolyl acetic acid — 25 ppm.	6.7	8.60	14.50	57.10
H — -do- — 50 ppm.	6.2	9.75	9.20	42.00
I — -do- — 100 ppm.	6.2	8.20	10.75	47.30
J — Trichlorophenoxy—propionic acid — 25 ppm.	6.5	6.35	8.90	38.15
K — -do- — 50 ppm.	6.3	5.60	9.90	39.15
L — -do- — 100 ppm.	7.9	4.70	5.35	19.15
M — Soaked in water without parchment cover	6.6	5.85	7.10	37.10
N — Soaked in water with parchment cover	5.8	10.20	9.05	49.30
O — No treatment—without parchment cover	5.4	7.60	9.45	37.15
P — No treatment—with parchment cover	6.2	11.60	12.15	62.60
General Mean	6.4	8.20	9.61	41.80
S.E.M.	—	58.54	84.47	1,361.00
Significance	No	No	No	No

TABLE 'A' — X

SOIL CULTIVATION EXPERIMENT

Locality: Coffee Research Sub-Station, Chethalli
Design: Latin Square
Treatments: Six
Replications: Six
Plot Size: Gross—160 plants
Net—112 plants

Year of commencement: 1953-54
Variety: Coorgs Arabica
Total Area under Experiment: 4.80 acres

Sl. No.	TREATMENTS	Calculated yield of ripe cherry in lb. per acre				Calculated mean yield of clean coffee in cwt. per acre			
		1954–55 Basic	Average for 5 years	1960–61	Average for 6 years	1954–55 Basic	Average for 5 years	1960–61	Average for 6 years
A	Trenching 1½ ft. deep	1,733	3,667	5,294	3,938	2.58	5.45	7.87	5.85
B	Trenching ¾ ft. deep	1,535	3,560	5,235	3,840	2.29	5.29	7.77	5.71
C	Renovation pitting	1,763	3,656	4,585	3,811	2.62	5.44	6.82	5.67
D	Light digging	1,358	3,655	5,460	3,957	2.02	5.46	8.12	5.91
E	Deep digging	1,613	3,658	5,410	3,892	2.40	5.44	8.05	5.88
F	Control (weeding only)	1,920	3,660	5,244	3,925	2.81	5.45	7.08	5.72
	General Mean	1,650	3,643	5,205	3,894	2.46	5.41	7.74	5.80
	S.E.M.	8.89	—	870.67	—	—	—	—	—
	Significance	Basic	—	No	—	—	—	—	—

II. BOTANY

1. Introduction:

1.1. Breeding of coffee with an attempt to improve it in vigour, resistance to leaf disease caused by *Hemileia vastatrix B. & Br.* and high yields of good quality beans was continued. The principal work of the Division continued to be (a) establishment of gene bank consisting of species, varieties and forms of coffee from countries outside India and from Indian sources; (b) comparative field trials of good bearers, both clonal and seedling progeny, for performance tests; (c) laboratory studies on cytology, embryology, and reactions of selections to races of leaf disease; (d) examination of seed plots of approved selections; (e) vegetative propagation of coffee by grafting and rooting of sucker cuttings, and, (f) collection and establishment of tree species for evaluating and utilizing these for shade purposes.

2. Gene Bank:

2.1. *Collections from countries outside India:*

2.1.1. During the year Dr. Branquinho d' Oliveira very kindly sent seeds of (i) Cof. 1343 *C. arabica Hibrido De Timor*, (ii) 134 *S.12 Kaffa* and its progeny Cof. 134/4-2 and Cof. 134/4-14; as well as, (iii) *C. racemosa. Hibrido De Timor* is recorded as immune to all the eleven races of leaf disease established at Coffee Rust Research Centre, Portugal, and Cof. 134/4 *S.12 Kaffa* as being resistant to all but the X race. Seedlings have been raised from these to study their performance.

2.1.2. *1953 series:* The five Brazilian types in this series continued to show high susceptibility to the common races—I & II of leaf disease and suffered defoliation. The progeny of B.A. 1, 12, 16 and 29 planted alongside for comparison showed upto 25% plants susceptible to these common races. The yield of the cultures is as follows:

Culture	Calculated yield of clean coffee in cwt. per acre	
	1960–61	Average for three years (1958–59 to 1960–61)
Bourbon amarelo	3.1	3.26
Bourbon vermelho	4.2	4.55
Caturra amarelo	7.6	3.59
Mundo novo	6.7	4.77
Laurina Maragogype	2.6	1.76
B.A. 1	6.6	4.99
B.A. 12	7.6	4.12
B.A. 16	12.3	5.57
B.A. 29	10.4	8.02

2.1.3. *1954 series:* 27 collections of Arabica as well as S.288 and S.446 are under observation. As reported in the previous years upto 85% of plants in *Taffarikela* and *S.12 Kaffa* showed a few spots of leaf disease on a few leaves. They, however, maintained vigorous growth and a heavy leaf crown. All the other collections including S.446 and upto 25% plants in S.288 showed high leaf disease susceptibility in the field.

2.1.3.1. The third crop harvested has ranged from 7.33 to 12.14 cwt./acre in *Taffarikela, S.12 Kaffa, Padang, Philippinean, Blue Mountain,* N.205 as well as K.P. 423. The rest of the collections have recorded lower yields than these.

2.1.3.2. Coffee samples from *S.12 Kaffa, Philippinean* and K.P. 423 were cup tasted in London. The former two have been assessed as F.A.Q. and the last as 'falling off'.

2.1.4. *1955 series:* 42 Arabica collections and 6 species of *Coffea* are under observation. All the Arabica collections show leaf disease susceptibility. Comparatively, *Rume Sudan* is not much affected. The first yield harvested has shown *Dilla (Melville)* at 4.4 cwt./acre to be the highest yielder.

2.1.5. *1956 series:* 60 collections of Arabica and 7 species of *Coffea* are under observation. Except collections of Ethiopian origin like *Badabuna Jimma Kaffa, Limma Jimma Kaffa, Misan Tafari Kaffa,* all the Arabica collections showed full susceptibility to leaf disease in the field. In the Ethiopian material upto 33% plants showed comparative freedom from leaf disease.

2.1.6. *1957 series:* 27 collections of Arabica and *C. canephora* are under observation. In this series also Ethiopian material like *Badabuna Jimma Kaffa, Badaca Kaffa, Misan Tafari Kaffa, Euiamba Kaffa* show comparative freedom from leaf disease. *Geisha* is yet another collection showing promise with vigorous and healthy growth and low leaf disease incidence.

2.1.7. *1958 series:* Except *Rume* and *Barbuk Sudan* the other collections show severe leaf disease infection and poor growth.

2.1.8. *1959 series:* Material screened at Rust Research Centre, Portugal, and mentioned as being resistant to Races I, and II and IV (W. W. Mayne's) of leaf disease were obtained and seedlings raised from these planted at the Station. The leaf disease susceptibility in the field is shown below:

Cultures	Susceptibility to leaf disease
113_1 S.6 Cioccie	Upto 33% (few spots on few leaves)
113_2 S.6 Cioccie	Upto 20% (-do-)
134_1 S.12 Kaffa	Upto 6% (-do-)
110_2 S.4 Agaro	Upto 36% (-do-)
110_5 S.4 Agaro	Upto 10% (-do-)
128_1 Dilla & Alghe	Nil (population consists of 6 plants)
68_{11} Dalecho	Nil (-do- 1 plant)

2.1.9. *1960 series:* Seedlings of *Murta, Cera, Laurina, Erecta, Yellow Bourbon, Maragogype* and *Xanthocarpa* were planted during June 1961 for field tests.

2.1.10. In the Arabica collections from countries outside India, those that originated from Ethiopia show promise of comparatively high degree of resistance to leaf disease. The material screened at the Rust Research Centre, Portugal, also appears useful. Promising material from the collections has been utilised for cross breeding with Station Selections.

2.2. *Collections from Indian sources:*

2.2.1. During the year some places in the natural habitat of *C. travancorensis* were surveyed and material obtained for inclusion in the Gene Bank. The species is met with in the forest enroute to Glenvans Estate from Gudalur as well as enroute to Nadubetta.

2.2.2. Spotting of outstanding plants in estates in India has been done as a subsidiary work when visiting estates for various purposes. From 1953 onwards, 33 collections were made and their seedling progeny established in contiguous plots at the Station. They include collections from Lalbagh, Kurkenmutty, Woger, Sulgode and Kogilehalla Estates in Mysore State and Vasambadi, Moganaad Peak, Scotforth and Kotada Estates in Madras State. Except a few individual plants in each, these collections show leaf disease susceptibility in the field and have recorded low yields. Also wide variation in the population is noticed, indicating that they are highly heterozygous. A few selected individual plants which show field resistance to leaf disease, vigorous growth and comparatively better yields—over 5 cwt./acre have been retained in these to raise their progeny for field tests.

2.2.3. Seedlings raised from collections from Kankanahalla, Koonmakki, Bagneheddal and Cannoncadoo Estates in Mysore State, were planted in the field in contiguous plots.

2.2.4. Marking of outstanding plants in private estates was continued during the year. Seedlings have been raised in the nursery from collections from Kollibyle Estate in Mysore State and Ammikolavi, Vethalai Kodakanal and Kotada Estates in Madras State.

3. Cross Breeding among Arabica Cultures:

3.1. With a view to evolve vigorous strains resistant to races of leaf disease and giving consistent high yields of good quality beans attempts at cross-combinations between Arabica cultures were continued. During the year 6 crosses were effected between selected plants in S.881 and S.882 (collections from Rume and Barbuk Sudan) exhibiting freedom from leaf disease in the field, S.450 (pedigree Kent) and a collection from Flora Estate in West Mysore which shows a high degree of uniformity in the population, vigorous growth and yields over 4.5 cwt./acre. The selected parent plants were also selfed to raise progeny for purposes of comparison.

3.2. *Field studies of advanced generations of selections and hybrids:*

3.2.1. The observational trials started in 1952 with the progeny of (1) six plants

of S.795, (2) one plant of S.333, and (3) 5 intra-crosses of Arabica cultures of B.A. series were pursued. Laboratory tests of the progeny of S.795 under controlled conditions show that upto 16% plants in these are susceptible to the common race II of leaf disease. These cultures recorded 4.9 to 11.1 cwt./acre yield during the year. Their averages over the last five years (1956-57 to 1960-61) ranges from 5.0 to 6.9 cwt./acre.

3.2.1.1. The progeny of S.333 recorded an yield of 6.0 cwt./acre during the year as against an average of 6.8 cwt./acre for 5 years from 1956-57 to 1960-61.

3.2.1.2. As in previous years, B.A. 21×B.A. 16 continued to show low, 6.6%, leaf disease susceptibility in the field. This culture yielded at 13.2 cwt./acre during the year as against the 5 years average of 4.7 cwt./acre. The remaining 4 intra-crosses show 15 to 30% leaf disease susceptibility in the field and yields ranging from 5 to 6.8 cwt./acre as against the 5 years average of 3.6 to 4.4 cwt./acre.

3.2.2. In the 1953 plantings, five cross-breds (intra-crosses between B.A.9, B.A.19, B.A.21 and B.A.23) and three hybrid collections from estates continue to be under observation. The susceptibility under field conditions in the intra-crosses ranges from nil to 30% and, the yield during the year, from 0.7 cwt./acre (B.A.23×B.A.21) to 6.7 cwt./acre (B.A.21×B.A.9) as against the 4 years (1957-58 to 1960-61) average ranging from 1.6 cwt./acre (B.A.23×B.A.21) to 3.5 cwt./acre.

3.2.2.1. The three hybrid collections recorded 2.1 to 25.5% leaf disease susceptibility in the field and yields from 2 to 4.1 cwt./acre during the year as against the 4 years average of 1.3 to 2.1 cwt./acre.

3.2.3. In the progeny of ten intra-crosses planted in 1954 leaf disease susceptibility showed a high increase during the year ranging from 11.1 to 75% as against nil to 12.5% in the previous year. Laboratory tests indicate that this may be due to race IV which appears to have gained ground in the field in the North and North-Easterly portions of the Station where these cultures are established.

3.2.3.1. The second yield of the cultures has ranged from 0.8 to 5.8 cwt./acre as against the first yield from 1.21 to 4.2 cwt./acre recorded last year.

3.2.4. Six intra-crosses from 1955 plantings have been retained for observations. In these B.A.22×B.A.12 continue to be promising with practically no leaf disease in the field and having vigorous growth. This is closely followed by the F2 of S.31×Kents arabica.

3.2.5. Among the 16 intra-crosses between Arabica cultures planted in 1956, S.1846 (S.576×S.583) shows a high degree of uniformity and vigorous growth and appears to be comparatively more promising than the other cultures.

3.2.5.1. In the six cultures of S.795 II generation planted in 1956, a few spots of leaf disease on a few leaves were seen in upto 44.7% plants. However, no defoliation occurred due to the disease. Laboratory tests are under way to find out the particular race of leaf disease affecting these plants. The cultures show vigorous growth and recorded the first full crop between 3.6 to 7.4 cwt./acre.

3.2.6. Among the 12 intra-crosses planted in 1957, F1 of B.A.13×1st Gen. of S.178, 2nd Gen. of S.44×S.795 and 1st Gen. of S.178×(S.26×Kent) are outstanding with vigorous growth and comparative freedom from leaf disease in the field. The 2nd Gen. of B.A.25 continues to maintain markedly vigorous growth.

3.2.7. Ten intra-crosses between the progeny of S.288, S.795 and S.178 and collections from Rume and Barbuk Sudan planted in 1958 continue to be under observation. The F1 progeny with Rume and Barbuk Sudan as either of the parents show pronounced leaf characters of these parental types.

3.2.8. Twelve intra-crosses between the progeny of S.288, S.795 and B.A.21 and collections from Rume and Barbuk, S.12 Kaffa, Padang and Philippinean planted during 1959 are under study. While it is too early to assess their performance, it is interesting to record that in the F1 populations of S.795×San Ramon, 54 to 69% plants with resemblance to San Ramon and having field resistance to leaf disease occur; as also 13.3 to 35% plants showing characters intermediate between the two parents as well as 8.7 to 17.8% plants with resemblance to S.795.

3.2.9. During 1960, 4 intra-crosses involving 1st Gen. of S.44, Kent, Rume, S.12 Kaffa, and Var. typica were planted in the field for study of their performance. Alongside these, 2nd Gen. progeny of S.795 and F2 of S.645×S.483 were also planted.

3.2.10. *Salient points from field studies on advanced generations and hybrids:*

3.2.10.1. A few salient points on observations made during the year on the field performance of advanced generations of selections and hybrids planted from 1952 may be noted:

3.2.10.1.1. *S.795 progeny:* The laboratory tests of the 1st gen. cultures have indicated that these are susceptible upto 16% to the common race II of leaf disease occurring on Kents. The cultures have recorded on an average of 5 years 5.0 to 5.9 cwt./acre yield.

3.2.10.1.1.1. While in the II gen. cultures laboratory tests are in progress, under field conditions a few spots of leaf disease on a few leaves are seen in upto 44.7% plants. It is possible that race IV is gaining ground. These cultures gave a first full crop from 3.6 to 7.4 cwt./acre.

3.2.10.1.2. *Intra-crosses of selections of B.A. series:* F1 of B.A.21×B.A.16 planted in 1952 continues to maintain satisfactory performance, with low, 6.6%, leaf disease susceptibility in the field. Its yield during the year was 13.2 cwt./acre against 5 years average of 4.7 cwt./acre.

3.2.10.1.2.1. F1 of B.A.21×B.A.9 planted during 1953 has low, 15.9%, leaf disease susceptibility in the field and has recorded 6.7 cwt./acre. F1 of B.A.23×B.A.21 shows freedom from leaf disease in the field; but, the yield is very poor being 0.7 cwt./acre.

3.2.10.1.2.2. In the cross-breds planted in 1954 the leaf disease susceptibility has risen to 75% in the field. Tests conducted show that race IV is gaining ground and the high percentage of leaf disease seen is attributable to this.

3.2.10.1.2.3. In the 1955 plantings, F1 of B.A.22×B.A.12 continues to be promising followed by F2 of S.31×Kent. The high degree of uniformity in the population as well as the vigorous growth of F1 of S.576×S.583 planted during 1956 is worth recording.

3.2.10.1.2.4. F1 of B.A.13×1st Gen. of S.178, 1st Gen. of S.178×(S.26×Kent) and 2nd Gen. of S.44×S.795 appear outstanding with their vigorous growth and comparative freedom from leaf disease among the cultures planted in 1957.

3.2.10.1.2.5. Race IV appears to be gaining ground in the North and North-Easterly portions of the Station estate. If and when this becomes a menace, the stock of Ethiopian collections will be useful against this since it is in these that field resistance is noticed continuously though they are situated in the plots at the Station where race IV was recorded last year. From this point the cultures planted from 1957-60 involving Station Selections S.795, S.288, S.333, S.44 (2nd Gen.), cross-bred with S.12 Kaffa, Taffarikela, Rume and Barbuk Sudan become important and intensive study of these is in progress.

4. Comparative Trials of Promising Arabica Cultures:

4.1. *Seedling progeny of selections of BA series:* Trials with the seedling progeny of 20 Arabica cultures of the B.A. series laid out during 1956 was continued. The cultures maintain field resistance to leaf disease and vigorous growth. A small crop allowed on a few nodes on the brown wood was harvested.

4.2. *Clonal progeny of selections of BA series:*

4.2.1. *B.A. Series I:* The randomised replicated trial with 20 cultures (B.A. 5, 6, 11, 12, 13, 19 to 27, 30 to 32, and 34 to 36) planted in 1951 and 1952 was continued. Though these cultures maintain field resistance to the common races of leaf disease (races I & II), during the year under report they suffered from infection by race IV. The average yields of the cultures in terms of clean coffee per acre is given in Table 'B'—I. On the mean of seven years yields, numerically, B.A.12 heads the others with 5.8 cwt./acre, closely followed in order by B.A.11, 19, 20, 13, 36 and 23.

4.2.2. *B.A. Series II:* The randomised replicated trial with 16 cultures (B.A.1, 4, 7, 8 to 10, 13 to 18, 28, 29, 33 and seedling progeny of B.A.19) planted during 1952 and 1953 was continued. This experiment laid out contiguous to B.A. series I also suffered from infection with race IV during the year. The average yield of the cultures in terms of clean coffee per acre is given in Table 'B'—II. On the mean of five years yields, numerically, B.A.18 has led the other cultures with 5.2 cwt./acre closely followed in order by B.A.13, 1, 28, 9 and 16.

4.3. *Latin square trial with selections:*

4.3.1. The trial laid out during 1949 at Coffee Research Sub-Station, Chethalli, with Station Selections S.795, S.288, S.645 and S.446 was continued. Tenth crop was recorded during the year. The data are given in Table 'B'—III. On the aggregate of ten years yields S.795 leads with 10.8 cwt./acre followed in order by S.645 with 8.4 cwt./acre, S.288 with 7.2 cwt./acre and S.446 with 5.9 cwt./acre.

5. Comparative Trials of Promising Robusta Cultures:

5.1. *Seedling progeny of selections of BR series:*

5.1.1. Trials laid out during 1956 with the seedling progeny of 12 Robusta cultures of the BR series (BR 1 to 3, 5, 6, 8 to 12, 14 and 17) was continued. The plants are growing vigorously.

5.2. *Clonal progeny of selections of BR series:*

5.2.1. *BR Series I:* The randomised replicated trial with 10 cultures (BR 2, 3, 5, 6, 7, 9, 11, 12, 15 and 17) planted in 1951 and 1952 was continued. The average yields of the cultures in terms of clean coffee per acre is given in Table 'B'—IV. On the average of six years yields BR 12, 9 and 6 are leading the others with over 4.6 cwt. per acre.

5.2.2. *BR Series II:* The randomised replicated trial with 10 cultures (BR 1, 4, 6, 8, 10, 13, 14, 16, 17 and seedling progeny of S.274) planted during 1952 and 1953 was continued. The average yields of the cultures in terms of clean coffee per acre is given in Table 'B'—V. On the average of 5 years yields BR 14 and 10 are leading the others with over 3.0 cwt./acre.

5.3. *Observational trial on the seedling progeny of outstanding plants from Hope Estate, Coorg, Mysore State:*

5.3.1. Plants raised from seeds of 40 marked plants in Hope Estate and established at Balehonnur Station during 1956 are continuing to have vigorous growth.

6. Interspecific Hybrids:

6.1. *C. canephora* × *C. arabica:* Studies were continued on these, their back crosses and further progeny. It is gratifying to note that in the progeny from selected parent plants in BC 2 and BC 3 showing close resemblance to *C. arabica*, there is comparatively high uniformity in the stand of the plants. Leaf disease susceptibility in these under field conditions is upto 9% as against 22.8%, 42.8% and 43.5% in BC 3, BC 2 and BC 1 respectively.

6.1.1. The crop recorded is as follows:

Culture	Calculated yield of clean coffee in cwt./acre
B.C. 1	6.5 (Average of 4 years between 20th and 23rd years of the culture)
B.C. 2	5.2 (-do- between 9th and 12th year of the culture)
B.C. 3	2.2 (-do- 2 „ between 5th and 6th year of the culture)

6.1.2. Out-turn ratio of cherry to clean coffee ranges from 6.1:1 to 9:1 and PB grades upto 73.8%. 'A' grade samples sent to London for cup quality tests recorded BC 2 with "falling off" and BC 3 with "F.A.Q. to falling off".

6.2. *Devamachy hybrids:*

6.2.1. Observations over a period of 5 years on the progeny of Devamachy× S.881 (collection from Rume Sudan) had shown that the culture remained free from leaf disease in the field. During the year upto 36.4% plants showed disease susceptibility in the field. These are under test to know whether race IV is active. Vigorous growth of the plants as well as heavy crown of leaf continue to be maintained. The first full crop during the year recorded 2.1 cwt./acre.

6.2.1.1. The remaining crosses between Devamachy collections and Arabica selections and collections show leaf disease susceptibility ranging from 43 to 100%. The first full crop during the year recorded from 1.2 to 4 cwt./acre.

6.2.2. Four crosses between Devamachy hybrid collections and S.795 and S.333 established in 1957 continued to be under observation. Comparatively the cross with S.333 as well as with S.1403 (II Gen. of S.795) are more vigorous; but a high variation in the population is observed.

6.3. *Crosses between diploid species:*

6.3.1. Crosses between *C. canephora*, *C. liberica*, *C. excelsa* and *C. eugenioides* continue to be under observation. An outstanding feature in these is the occurrence of a mixoploid plant in the F1 of *C. liberica*×*C. eugenioides* on which tetraploid suckers arose which show the closest resemblance in morphological feature to *C. arabica*. This is a major find of the year since it gives indications on the origin of *C. arabica* and supports the view that this species is an allotetraploid. It is further interesting to record that while under field conditions this plant so far shows freedom from leaf disease, in the laboratory tests it shows susceptibility to race II, while repeated inoculations with race IV have been failures.

6.3.2. Attempts are under way to induce tetraploidy by Colchicine treatment among the other F1 plants, to observe their behaviour.

7. Studies on Reaction of Selections to Races of Leaf Disease (Hemileia Vastatrix B & Br.):

7.1. Consequent on the appointment of an Asst. Botanist, the work of isolation of races of leaf disease and testing selections against these was re-commenced from November 1960.

7.2. It is fairly clear from information so far collected that susceptibility in *C. arabica* to races other than race I would mean susceptibility to race I also. Therefore, necessity was not felt for testing of selections to race I. Races I, II and IV were isolated and stock cultures of these built up. Race III has not been so far isolated. Parents of S.795, S.795 and its progeny have been tested for reactions to races II and IV. Mayne's technique of inoculation on leaf discs is invariably followed. Reactions recorded are as follows:

Cultures	Reaction to race	
	II	IV
S. 288-23 .... 0 parent	—	+
K. Kent III Sec. + 4/10 0 parent	+	+
S. 474 .... F1 population	+ (23.5%)	
	— (76.5%)	
S. 474 4/14 Parent plant of S. 795	—	+
S. 795 .... F2 population	+ (22.9%) + (100%)	
	— (77.1%)	
S. 1403 to 1408 .... F3 population	+ (6.25 to 17.4%)	
	— (93.75 to 82.6%)	
S. 1824 .... F4 population	+ (6.8%)—(93.2%)	

Note: + means susceptibility; and — means resistance.

7.3. Seedlings raised from selected plants in the F3 cultures are also being inoculated with the races for testing their reactions.

7.4. From work so far done it is noticed that the incubation period *i.e.*, the interval between inoculation and visible yellow spot formation, ranges from 9 to 22 days depending on seasonal conditions.

8. Cytological and Embryological Studies:

8.1. *Cytological studies:* These studies were continued as in previous years.

8.1.1. *Occurrence of haploids and polyploids in Kents arabica and station selections:*

8.1.1.1. The seven seedlings from seeds from the haploid Kent plant reported upon in the previous year continued to be under observation. In addition to the 2 tetraploids seen in these, further 2 plants also developed tetraploidy. The remaining 3 seedlings continue to show retarded growth.

8.1.1.2. A haploid plant among S.795 was marked in a neighbouring estate. Meiosis in this recorded similar irregularities as reported in the haploid Kent plant in the previous year.

8.1.1.3. One plant in each of the progeny from (1) S.288-23 established in 1939, (2) B.A. 1 established in 1953, and (3) S.795 1st Gen. established in 1952, show hexaploidy—2n=66. These plants have been marked and kept under observation.

8.1.2. Seeds from the tetraploid robusta plant failed to germinate on sowing.

8.1.3. *Crosses between diploid species:*

8.1.3.1. Parent plants in *C. liberica*, *C. excelsa* and *C. eugenioides* that have been

utilised for crossing between these as well as one plant in each of the F1 of *C. liberica*× *C. eugenioides* and *C. excelsa*×*C. eugenioides* were utilised for meiotic studies. Details of these studies are under publication elsewhere. Meiosis is found to be regular in all the parental plants; it is highly irregular in the F1 plants studied showing univalents, chromatic bridges, fragmentation and unreduced gametes. Chromatin bridges are also seen to occur in *C. excelsa* and *C. eugenioides*.

8.2. *Embryological studies:*

8.2.1. The triage studies initiated from 1958 were continued. A paper entitled "Triage in plantation coffee in India", giving the results of studies has been published in *Indian Coffee* Vol. XXV No. 6.

8.2.2. From a critical analysis it is found that more than one factor is responsible for triage occurrence. Upto half of the total triage in the Station Selections studied and upto $^1/_3$ of the total triage in Coorg and Kent Arabica are due to elephant, malformed and other abnormal beans which develop on account of false polyembryony and defective endosperm. These components show seasonal fluctuations.

8.2.3. In the case of Station Selections, especially S.795, there are indications as in its 1st and 2nd Gen. progeny, that it may be possible to reduce by further selection the false polyembryony so as to bring it to the level found in Coorg and Kent Arabica.

8.2.4. The environmental and crop processing operations appear to account for the remaining $\frac{1}{2}$ of the total triage in Station Selections and $^2/_3$ of the total triage in Coorg and Kent Arabica.

8.2.5. Basing on an analysis of information so far collected suggestions have been incorporated in the published paper, with a view to improve the triage content stressing the necessity for improving the environment and crop processing practices.

9. Vegetative Propagation:

9.1. As reported in previous years, the standardised technique for conversion of Robusta and hybrid stocks without stumping them at first, by wedge grafting green tender suckers arising on the main stem at 12 to 15 inches from ground level is being successfully adopted for large scale grafting in estates. This has come in handy in reclaiming eelworm infested areas where grafts with Arabica scion wood on tolerant Robusta root stocks are being established. The technique has also been extended to convert the crown of leaf disease susceptible segregates in the blocks of Station Selections with scion wood from resistant plants.

9.2. Demonstrations of the grafting technique were continued to be held in the Liaison Districts which served to train the estate personnel and thus disseminate the technical knowledge.

9.3. *Rooting of sucker cuttings:* Clonal plants from sucker cuttings from (a) indicator plants for races of leaf disease, (b) selected plants in 1st Gen. of S.795 with

low triage, (c) B.A. series selections and, (d) supplying requirements of the Chemistry Division, were raised.

10. Seed Plots of Approved Selections:

10.1. *Seed Plots at Balehonnur Station:* Seed plots of S.795, S.947, S.532 and S.846 were continued to be maintained. The crop recorded is as follows:

Seed plots	Yield in terms of clean coffee in cwt./acre	
	1960-61	Average for 3 years (1958-59 to 1960-61)
1954 plantings:		
S. 795	9.3	5.7
S. 947	8.2	4.9
S. 846	10.5	4.7
S. 532	1.3	1.0
S. 645	4.4	1.9
1955 plantings:		Average for 2 years (1959-60 and 1960-61)
S. 795	1.6	1.9

10.2. *Regional Seed Plots:* The zonal seed plots of S.795 established in 1954-55 for obtaining seed coffee for supplies to planters were continued. In addition to these, five more seed plots of S.795 were selected in Saklespur Liaison District, Mysore State, South Wynaad and South Travancore in Kerala State and Pulneys in Madras State to meet the requirements of the respective zones. Another seed plot of S.795 has been provisionally fixed up in Shevaroys, Madras State, to meet local requirements. The following are the estates selected:

Mysore State:

1. Bagneheddal Estate, Chikmagalur P.O.
2. Urvinkhan Estate, Javali P.O.
3. Sirigur Estate, Cheekanahalli P.O.
4. Kogarvalli Estate, Saklespur P.O.
5. Kibbetta Estate, Somwarpet P.O.
6. Balagunda Estate, Somwarpet P.O.
7. Madapur 'A' Estate, Madapur P.O.
8. Haradoor Estate, Suntikoppa P.O.
9. Pannia Estate, Suntikoppa P.O.

Kerala State:

1. Padaripara Estate, Kalpetta P.O.
2. Vagamalai Estate, Peruvanthanam P.O.

Madras State:

1. Glenvans Estate, New Hope P.O.
2. Vethalai Kodakanal Estate, Pattiveeranpatti P.O.
3. Mundakambadi Estate, Yercaud P.O. (Provisional)

10.3. *Seed preparation at Balehonnur Station:* 1026 lb. seeds of Arabica Selections, 711 lb. of Robusta Selections and 27 lb. of Excelsa were prepared and delivered to the Senior Liaison Officer (Devt.) for distribution.

10.4. *Seed Supply to Countries Outside India:* 4 lb. 14 oz. seeds of Arabica Selections, 2¼ lb. of Robusta Selections, and, sample seeds of *C. travancorensis* were supplied to (1) Plant Pathologist, Department of Agriculture, Peradeniya, (2) Research Officer (Cacao and Coffee), School of Agriculture, Peradeniya, (3) Botanist and Senior Agricultural Officer, Department of Agriculture, Peradeniya, (4) Chief Conservator of Forests, East Pakistan, Dacca, (5) Director, Balai Penjelidikan Perkebunan Besar, Bogor, and, (6) Dr. Branquinho d'Oliveira, Estacao Agronomica Nacional, Portugal. Seeds of *C. travancorensis* and S.1824 (II Gen. of S.795) were supplied to Dr. d' Oliveira for his studies on reaction of these to races of leaf disease fungus.

11. Multiple Vs. Single Stem System of Growing Coffee:

11.1. Four sets of observational trials on the multiple vs. single stem system of growing coffee laid out in 1950 and 1951 with a view to gain local knowledge of the relative merits of the two systems were continued. The yield data are given in Table 'B'—VI to 'B'—IX.

11.2. Ten years records from three sets of trials with Arabica coffee continues to indicate that single stem plots have out-yielded multiple stem plots by 26.6% to 1.5%. However, these differences are not significant.

11.2.1. One experiment in this series is discontinued and the plants uprooted for replanting with newer selections for testing their performance.

11.3. The trial with Robusta coffee shows that on the aggregate of 9 years yields the single stem plots have continued to record increase over the multiple stem an increase of 29.6%.

12. Shade Trees for Coffee:

12.1. One pound seeds of *Macsopsis eminii* were supplied to the Agricultural Botanist, Essential Oils Research Centre, Cinchona, Coimbatore District, Madras State.

12.2. Sample seeds of *Albizzia maranguensis* were supplied to Kodeneri Estate in Nilgiris District, Madras State.

12.3. *Cordia abyssinica*, *Albizzia maranguensis*, *A. coriaria*, *A. sumatrana*, *A. procera*, *Ruprechtia vivoru* and *Derris robusta* are growing vigorously.

R. L. NARASIMHASWAMY,
Botanist

TABLE 'B' — I

Comparative Trials of Clonal Progeny — B.A. Series I

Locality: Balehonnur (Mysore State)
Variety: Arabica Hybrids
Replications: Eight
Area of Experimental Block: 59.5 Cents
Guard Rows: One on either side
Layout: Randomized block
Plot: 3 plants in a row
Treatments: 20 cultures of the B.A. series
Spacing: 6 ft. × 6 ft.
Shade: Natural shade

Yield of Replications — Calculated Yield of Clean Coffee in cwt. per acre (1,200 plants)

Cultures	YIELD IN CWT. DURING							
	1954-55	1955-56	1956-57	1957-58	1958-59	1959-60	1960-61	Average for 7 years
B.A. 5	0.60	1.49	0.95	7.34	4.36	1.27	6.877	3.25
B.A. 6	1.05	1.68	1.07	5.02	6.51	2.78	7.656	3.66
B.A. 11	2.25	2.84	3.95	11.01	5.29	4.41	10.145	5.74
B.A. 12	5.22	3.35	2.34	10.92	5.88	4.59	8.21	5.75
B.A. 13	2.79	1.19	3.65	9.14	7.04	2.94	8.829	5.00
B.A. 19	5.76	2.21	2.29	8.24	5.81	2.50	9.877	5.22
B.A. 20	3.15	1.51	3.12	6.57	6.39	3.02	9.115	5.15
B.A. 21	0.96	1.08	1.59	9.99	5.66	0.53	5.216	3.56
B.A. 22	2.43	2.39	1.65	7.50	4.54	0.42	8.765	3.94
B.A. 23	3.45	2.26	3.05	9.73	5.67	0.53	5.57	4.32
B.A. 24	1.14	0.31	2.48	9.01	3.52	1.33	6.06	3.40
B.A. 25	1.44	1.11	1.47	10.55	4.32	0.47	6.23	3.65
B.A. 26	0.75	1.41	1.79	4.41	2.37	0.45	3.33	2.07
B.A. 27	1.05	1.51	1.18	6.57	3.46	0.85	5.46	2.86
B.A. 30	0.48	1.26	1.23	6.92	3.47	0.54	4.14	2.57
B.A. 31	2.85	3.94	0.98	6.42	2.21	0.05	3.61	2.86
B.A. 32	1.08	1.60	0.49	3.68	2.74	0.79	2.33	1.81
B.A. 34	1.41	1.68	0.31	2.64	1.93	0.43	3.23	1.66
B.A. 35	2.61	2.88	3.07	6.82	3.34	3.99	7.34	4.29
B.A. 36	2.04	2.18	1.67	10.74	5.24	3.78	8.56	4.88

TABLE 'B' — II

Comparative Trials of Clonal Progeny — B.A. Series II

Locality: Balehonnur (Mysore State)
Variety: Arabica Hybrids
Replications: Six
Area of Experimental Block: 45 Cents
Spacing: 6 ft. × 6 ft.
Guard Rows: One on either side
Shade: Natural shade
Layout: Randomized block
Plots: 3 plants in a row
Treatment: 15 Arabica cultures of B.A. series and seedling progeny of 645.1/6 (B.A. 19)

Mean Yield of Replications — Calculated Yield of Clean Coffee in cwt. per acre (1,200 plants)

Cultures	YIELD IN CWT. DURING					
	1956-57	1957-58	1958-59	1959-60	1960-61	Average for 5 years
B.A. 1	1.90	3.49	5.08	2.69	7.1	4.52
B.A. 4	1.12	3.46	3.90	1.06	6.7	3.24
B.A. 7	0.20	4.13	1.93	0.52	8.4	3.36
B.A. 8	0.22	0.14	1.15	0.11	0.8	0.48
B.A. 9	1.46	4.22	4.54	3.14	8.4	4.35
B.A. 10	1.07	2.91	1.83	0.95	6.3	2 61
B.A. 13	1.90	4.62	3.30	4.33	8.6	4.55
B.A. 14	0.20	2.38	2.89	0.09	3.8	1.87
B.A. 15	0.10	0.85	1.14	0.22	2.3	0 92
B.A. 16	4.49	5.21	2.59	2.31	6.5	4.22
B.A. 17	0.15	2.31	2.35	1.67	4.5	2.19
B.A. 18	5.49	5.30	4.94	2.32	7.7	5 15
B.A. 19 (645.1/6)	2.75	2.21	6.48	2.01	4.9	3.67
B.A. 28	6.15	5.44	3.13	2.83	4.7	4.45
B.A. 29	0.63	3.39	2.89	2.29	6.6	3.16
B.A. 33	2.78	3.14	5.23	1.00	6.4	3.16

TABLE 'B'—III

Arabica Varietal Trial at the Coffee Research Sub-Station, Chethalli P.O., Coorg, Mysore State

Locality: Chethalli, Coorg (Mysore State)
Treatments: 4 (A: S. 446, B: S. 795, C: S. 645, D: S. 288)
Shade: Natural shade
Layout: Latin square
Size of Plots: 12×8 = 96 plants
Spacing: 6½′ × 6½′
Planted: 1949
Area of Experimental Block: 1.49 acres

Yield per acre of Ripe Cherry in lb. and Calculated Yield of Clean Coffee in cwt. per acre

Year	Description of crop	Yield : Clean (A)	Ripe Coffee (B)	Cherry in cwt. (C)	In lb. per acre (D)	Mean	Sem %	Signi-ficant or not	Critical differenec	Conclusion
		S.446	S.795	S.645	S.288					
1952	Ripe Cherry	875	255	193	133	364	23.48	Yes	191	A B C D
	Clean Coffee	1.30	0.38	0.29	0.20	0.54			0.43	
1953	Ripe Cherry	3,746	1,897	1,366	808	1,954	16.22	Yes	1,095	A B C D
	Clean Coffee	5.57	2.82	2.03	1.20	2.91			1.63	
1954	Ripe Cherry	1,541	3,402	2,478	1,498	2,230	14.13	Yes	1,096	B C A D
	Clean Coffee	2.29	5.06	3.69	2.23	3.32			1.63	
1955	Ripe Cherry	6,939	9,043	4,865	4,404	6,313		Yes		B A C D
	Clean Coffee	8.84	13.46	7.24	6.55	9.02				
1956	Ripe Cherry	1,997	8,551	5,821	4,259	5,157		Yes		B C D A
	Clean Coffee	3.00	12.70	8.60	6.30	7.65				
1957	Ripe Cherry	9,208	10,548	9,422	8,765	9,486		No		B C A D
	Clean Coffee	13.70	15.70	14.02	13.04	14.12				
1958	Ripe Cherry	3,000	15,838	12,584	8,872	10,074	9.21	Yes	2,375	B C D A
	Clean Coffee	4.58	23.55	18.75	13.22	15.03			3.39	
1959	Ripe Cherry	3,991	4,200	4,638	3,974	4,201		No		C B A D
	Clean Coffee	6.00	6.20	6.90	5.90	6.20				
1960	Ripe Cherry	4,496	5,172	3,323	2,328	3,830		No	—	B A C D
	Clean Coffee	6.50	7.40	4.90	3.40	5.60				
1961	Ripe Cherry	4,393	13,202	11,321	10,038	9,738		Yes	6.003	B C D A
	Clean Coffee	6.39	19.20	16.47	14.60	14.16				

TABLE 'B' — IV

Comparative Trials of Clonal Progeny — B.R. Series I

Locality: Balehonnur (Mysore State)
Variety: Robusta
Treatments: 10 cultures of the B.R. series
Replications: 9
Spacing: 9 ft. × 9 ft.
Layout: Randomized block
Plot: 3 plants in a row
Guard Rows: One on either side
Area of Experimental Block: 96 Cents

Mean Yield of Cultures — Calculated Yield of Clean Coffee in cwt. per acre (538 plants)

Cultures	YIELD DURING						
	1955-56	1956-57	1957-58	1958-59	1959-60	1960-61	Average for 6 years
B.R. 2	0.4	0.81	3.87	3.01	—	7.58	2.61
B.R. 3	1.7	0.98	6.73	3.42	0.08	6.31	3.20
B.R. 5	1.1	1.04	5.78	5.20	0.09	7.12	3.39
B.R. 6	2.9	1.89	8.24	5.24	—	9.50	4.63
B.R. 7	1.4	2.28	4.75	4.21	0.87	6.97	3.41
B.R. 9	1.8	0.43	8.80	3.35	0.07	14.27	4.79
B.R. 11	1.5	1.10	4.96	1.55	0.08	10.45	3.27
B.R. 12	4.2	0.93	8.78	2.83	0.19	11.92	4.81
B.R. 15	0.3	0.82	3.61	4.45	1.92	5.94	2.84
B.R. 17	1.4	0.81	1.14	4.36	—	7.15	2.52

TABLE 'B'—V

Comparative Trials of Clonal Progeny—B.R. Series II

Locality: Balehonnur (Mysore State)

Variety: Robusta

Treatments: 9 cultures of the B.R. series and seedling progeny of S. 274 (Robusta)

Replications: 8

Spacing: 9 ft. × 9 ft.

Area of Experimental Plots: 93 Cents

Layout: Randomized blocks

Plot: 3 plants in a row

Guard Rows: One on either side

Shade: Natural shade

Treatments: The cultures of the B.R. series are:—
B.R. 1, B.R. 4, B.R. 6, B.R. 8, B.R. 10, B.R. 13, B.R. 14, B.R. 16, B.R. 17, and S. 274 seedlings

Mean Yield of Replications—Calculated Yield of Clean Coffee in cwt. per acre (538 plants)

Cultures	YIELD DURING					
	1956-57	1957-58	1958-59	1959-60	1960-61	Average of 5 years
B.R. 1	0.44	0.35	0.15	—	2.55	0.87
B.R. 4	0.97	1.59	1.80	—	5.01	1.87
B.R. 6	0.55	2.53	2.00	—	6.02	2.22
B.R. 8	0.66	1.68	2.75	—	4.38	1.89
B.R. 10	1.23	2.53	4.84	—	6.20	2.97
B.R. 13	1.03	1.95	1.38	—	3.51	1.57
B.R. 14	1.99	2.57	5.26	—	6.73	3.31
B.R. 16	0.58	2.19	2.28	—	3.21	1.65
B.R. 17	0.52	1.04	1.62	—	2.95	1.23
S. 274 Robusta seedling	0.92	2.07	1.12	—	3.52	1.53

TABLE 'B'— VI

EXPERIMENT I

Yield Data of Multiple Stem vs. Single Stem System of Growing Coffee

Locality: Balehonnur (Mysore State)
Variety: S. 288, S. 333, S. 433, S. 434 and Kents (each variety having 12 rows of 16 plants in each row)
Treatments: A. Single stem; B. Multiple stem
Layout: AB, BA pattern

Age of Plants: 15 years from seed
Period of Conversion: May 1950
Shade: Natural shade
Spacing: 6 ft. × 6 ft.
Area of Experimental Block: 95.2 Cents

Yield of Ripe Cherry (actual) in lb. and Calculated Yield of Clean Coffee in cwt./acre (1,200 plants)

Year	Description of crop	A. Single Stem							B. Multiple Stem						
		S.288	S.333	Kents	S.433	S.434	Kents	Mean	S.288	S.333	Kents	S.433	S.434	Kents	Mean
1952	Ripe Cherry	63	83	19	7	22	22	36	21	8	7	4	5	3	8
	Clean Coffee	1.17	1.52	0.35	0.13	0.42	0.41	0.66	0.38	0.15	0.13	0.07	0.09	0.06	0.15
1953	Ripe Cherry	55	98	32	103	116	10	69	177	83	28	99	135	8	88
	Clean Coffee	1.02	1.82	0.60	1.92	2.16	0.18	1.28	3.28	1.53	0.52	1.83	2.52	0.15	1.64
1954	Ripe Cherry	243	421	226	227	416	374	318	463	338	370	452	643	160	404
	Clean Coffee	4.52	7.83	4.20	4.22	7.74	6.96	5.91	8.6	6.28	6.88	8.41	11.96	2.98	7.52
1955	Ripe Cherry	180	128	115	49	62	75	101	144	125	113	73	56	84	99
	Clean Coffee	3.34	2.38	2.13	0.91	1.15	1.39	1.88	2.68	2.32	2.12	1.36	1.04	1.56	1.85
1956	Ripe Cherry	643	597	404	328	539	248	460	880	622	267	225	367	117	413
	Clean Coffee	11.96	11.14	7.51	6.10	10.03	4.61	8.56	16.37	12.46	4.97	4.19	6.82	1.18	7.83
1957	Ripe Cherry	206	119	45	74	58	40	90	147	118	53	92	135	70	103
	Clean Coffee	3.83	2.21	0.84	1.38	1.08	0.74	1.68	2.73	2.19	0.99	1.41	2.52	1.30	1.86
1958	Ripe Cherry	904	982	253	348	653	362	584	445	310	140	196	224	227	257
	Clean Coffee	16.81	18.27	4.71	6.47	12.15	6.73	10.86	8.28	5.77	2.60	3.65	4.17	4.22	4.78
1959	Ripe Cherry	328	257	126	182	136	89	186	287	233	47	129	168	192	176
	Clean Coffee	6.10	4.77	2.34	3.39	2.53	1.65	3.46	4.48	4.33	0.87	2.40	3.13	3.57	3.13
1960	Ripe Cherry	529	439	354	190	634	463	435	265	184	318	51	364	141	221
	Clean Coffee	9.78	8.17	6.36	3.53	11.79	8.61	8.04	4.92	3.42	5.92	0.95	6.77	2.62	4.10
1961	Ripe Cherry	648	390	78	82	87	130	236	378	154	240	96	130	301	216
	Clean Coffee	7.14	7.33	1.44	1.54	1.52	2.41	3.56	7.16	2.89	4.46	1.78	2.41	5.59	4.04
Mean	Ripe Cherry	380	351	167	159	272	181	251	321	218	158	142	253	130	204
	Clean Coffee	6.56	6.54	3.04	2.96	4.06	3.37	4.42	5.89	4.13	2.95	2.61	4.14	2.32	3.67

Note: 1) 6 lb. of ripe cherry has been taken to yield 1 lb. of clean coffee.
2) On the aggregate of 10 years yields, the multiple stem plots have registered a decrease of 26.6% over the single stem plots.

TABLE 'B' — VII

EXPERIMENT II

Yield Data of Multiple Stem vs. Single Stem System of Growing Coffee

Locality: Balehonnur (Mysore State)
Variety: Arabica Hybrids
Treatments: 4 during the year of conversion
Replications: 4
Shade: Natural shade
Area of the Experimental Block: 105.8 Cents

Layout: Randomized blocks
Plot: 4×16 = 64 plants
Spacing: 6 ft. × 6 ft.
Age of Plants: 28 years from seed
Period of Conversion: March 1951

Treatments: A. Single stem.

B. Primary branches on one side were pruned off during March 1951 to encourage free growth of suckers, for forming the multiple stems. After crop harvest during March 1952, the main stem was stumped to a height of 2 feet from ground level retaining a primary branch to form the lung branch. The three suckers form the multiple stems.

C. Extended centring upto one foot from the centre was done during the year of conversion (March 1951) to facilitate free growth of three suckers for forming the multiple stems. After crop harvest during March 1952, the main stem was stumped to a height of 2 feet from ground level, retaining a primary branch to form the lung branch. The three suckers form the multiple stems.

D. Except the two top primary branches, all the other branches were cut down during the year of conversion (March 1951) to facilitate the free growth of three suckers. After crop harvest during March 1952, the top most primary branch was retained to act as a lung branch and the three suckers form the multiple stems.

Mean Yield of Ripe Cherry (actual) in lb. and Calculated Yield of Clean Coffee in cwt. per acre (1,200 plants)

Treatments	RIPE CHERRY (Actual) in lb.										CLEAN COFFEE (Calculated) in cwt.										Mean of 10 Years
	1952*	1953	1954	1955	1956	1957	1958	1959	1960	1961	1952*	1953	1954	1955	1956	1957	1958	1959	1960	1961	
A.	38.63	47.14	208.46	100.44	190.83	393.70	256.9	76.75	70.30	60.70	1.08	1.31	5.81	2.80	5.32	10.98	7.17	2.14	1.96	1.69	4.02
B.	22.11	12.24	262.16	92.31	192.90	388.90	222.6	93.63	53.60	56.70	0.62	0.34	7.31	2.58	5.40	10.85	6.21	2.61	1.50	1.59	3.90
C.	24.62	26.11	272.46	110.06	251.00	388.00	267.70	33.19	74.20	61.20	0.68	0.73	7.66	3.07	7.00	10.60	7.47	0.93	2.07	1.71	4.19
D.	38.38	34.73	246.84	99.38	225.49	371.00	257.25	50.00	68.18	38.30	1.07	0.97	6.77	2.77	6.29	10.35	7.18	1.40	1.90	1.07	3.96

* Crop of the year of conversion.

Note: 1) 6 lb. of ripe cherry has been taken to yield 1 lb. of clean coffee.

2) On the average of 10 years yields, treatments B and D have registered a decrease of 2.98% and 1.49% respectively over that of the single stem (treatment A), while treatment C has registered an increase of 3.73% over the single stem.

TABLE 'B'—VIII

EXPERIMENT III

Yield Data of Multiple Stem vs. Single Stem System of Growing Coffee

Locality: Balehonnur (Mysore State)

Variety: Arabica Hybrids

Treatments: 2 (A. Single stem; B. Multiple stem)

Replications: 21

Shade: Natural shade

Area of Experimental Plot: 52 Cents

Layout: AB, BA pattern

Plot: 16 plants in a row

Spacing: 6 ft. × 6 ft.

Age of Plants: 17 years from seed

Period of Conversion: March 1951

Mean Yield of Ripe Cherry (actual) in lb. and Calculated Yield of Clean Coffee in cwt. per acre (1,200 plants)

Treatments	RIPE CHERRY (Actual) in lb.											CLEAN COFFEE (Calculated) in cwt.										
	1952*	1953	1954	1955	1956	1957	1958	1959	1960	1961	Average 10 years	1952*	1953	1954	1955	1956	1957	1958	1959	1960	1961	Average 10 years
A.	5.78	19.43	24.72	18.99	11.94	39.29	15.00	40.71	13.69	35.95	22.50	0.64	2.17	2.76	2.12	1.32	4.38	1.67	4.54	1.53	4.01	2.51
B.	3.90	8.03	21.49	15.20	24.82	42.27	18.24	32.81	11.35	35.61	21.37	0.44	0.89	2.40	1.69	2.80	4.72	2.04	3.66	1.27	3.98	2.35

* Crop of the year of conversion.

Note: 1) 6 lb. of ripe cherry has been taken to yield 1 lb. of clean coffee.

2) On the aggregate of 10 years yield, the multiple stem plots have registered a decrease of 6.3% over that of the single stem plots.

3) This experiment is discontinued.

TABLE 'B' — IX

Yield Data of Plots on Multiple Stem vs. Single Stem of Growing Coffee

Locality: Balehonnur (Mysore State)

Layout: Opposite quadrants on a rectangular block are on each of two treatments

Variety: Robusta

Treatments: 2 (A. Single stem; B. Multiple stem)

Shade: Natural shade

Spacing: 9 ft. × 9 ft.

Age of Plants: 15 years from seed

Area of Experimental Block: 60.60 Cents

Period of Conversion: September 1951

Mean Yield of Ripe Cherry per Plot (actual) in lb. and Calculated Yield of Clean Coffee in cwt./acre (538 plants)

Year	Description of the crop	Ripe Cherry in lb. and Clean Coffee in cwt./acre	
		A. Single stem	B. Multiple stem
1953	Ripe Cherry	121.06	52.69
	Clean Coffee	1.33	0.58
1954	Ripe Cherry	110.30	153.63
	Clean Coffee	1.20	1.61
1955	Ripe Cherry	138.00	105.34
	Clean Coffee	1.50	1.15
1956	Ripe Cherry	312.00	213.50
	Clean Coffee	3.41	2.35
1957	Ripe Cherry	394.00	136.00
	Clean Coffee	4.30	1.49
1958	Ripe Cherry	229.63	168.00
	Clean Coffee	2.51	1.83
1959	Ripe Cherry	484.50	367.00
	Clean Coffee	5.29	4.01
1960	Ripe Cherry	69.50	21.00
	Clean Coffee	0.76	0.23
1961	Ripe Cherry	1,313.00	1,232.50
	Clean Coffee	14.33	13.47
Mean	Ripe Cherry	352.44	272.18
	Clean Coffee	3.85	2.97

Note: 1) 5 lb. of Ripe Cherry has been taken to yield 1 lb. of Clean Coffee.

2) Existing old multiple stems have been removed to allow a new cycle of suckers to develop.

3) On the aggregate of 9 years yield, the single stem plots have registered an increase of 29.6% over the multiple stem plots.

III. CHEMISTRY

1. Experiments on the manurial requirements of coffee, land management with special reference to soil and moisture conservation, influence of trace elements on the growth and health factors formed the main items of work of this Division. The Division also attended to the routine examination of soils and plant materials for advisory work and undertook visits to problem areas for investigation and advice on soil and crop husbandry.

FIELD EXPERIMENTS

2. Manurial Experiments:

2.1. *Studies on the Essential Requirements of Plant Foods, N.P.K. for Coffee in Relation to Improvement in Yield (New Manurial Series—I):*

2.1.1. Since the start of this experiment in 1937, twenty-one crops have so far been picked. The plant population as mentioned in the earlier reports remains at 20 plants per sub-plot. The data, along with the results of the statistical analysis, are presented in Appendix 'C' I.

2.1.2. It is seen from the data that the treatments are *significant* in the case of ripe cherry. Treatment B (N+P) is *significantly* superior to the Treatment E (Control—No manure), which has recorded the least yield. The actual crop picked from net plot is 3,293.75 lb. as against 189.28 lb. recorded last year. Treatment B (N+P) has recorded good crop this season and is followed by the Treatment D (N+P+K). It may be mentioned that the Treatment B (N+P) is consistently recording good yields and this observation is in conformity with the previous observations. These plots were sprinkled last year first in January and was followed up by another sprinkling in February. The regular blossom showers were received in April. Thus the plants overcame the moisture stress in the drought period and were in a position to produce a better crop than the previous one.

2.1.3. Statistical analysis of the data on clean coffee shows that the treatments are *significant*. Treatment B (N+P) is *significantly superior* to the Treatments C (N+K) and E (Control). Treatments B (N+P), D (N+P+K) and A (N) are all *on par*. It is interesting to note that the Treatment B (N+P) is *superior* to the other treatments and has been so, in previous years. Statistical analyses on the percentage of floats by weight and volume show that the treatments are *not significant*. The percentage of floats by weight is highest in the Treatments C (N+K) and E (Control). It is comparatively low in the other treatments.

2.2. *Studies on the Manurial Requirement of Coffee in Relation to Improvement in Yield:*

2.2.1. *N.P.K. Trial with Varying Levels of Nitrogen, Phosphorus and Potassium (Fundamental Experiments in pH Cisterns):* Only two out of the thirty-six plants did not record any crop. The crop recorded this year is much higher than in the previous year. The yield data are presented in Appendix 'C' II. It is seen from the data that the

treatments are *not significant*. The trends noticed are as follows: Treatment C (45:30:40) has recorded high yield and the Treatment A (20:30:40) has recorded the least yield. As the data is varying from year to year, it is difficult to draw any conclusion. Statistical analyses of the data on clean coffee, percentage of floats by weight and volume reveal that the treatments are *not significant*. In the case of clean coffee, Treatment C (45:30:40) has recorded higher yield than the others. Regarding the percentage of floats by weight, the Treatment F (45:67.5:90) gives the highest. Regarding the percentage of floats by volume, Treatment C (45:30:40) gives the highest.

2.2.2. *N.P.K. Trials with Varying Levels of Nitrogen, with Constant Levels of Phosphorus and Potassium (17-acre Manurial Experiments—1952 Clearing):* This experiment, as described in the previous Annual Reports, was continued. The plants overcame the moisture stress mainly due to the sprinkling in January, which was followed up again in February, with the regular blossom showers occurring in April, resulting in a good blossom. The yield record of the experiment is presented in Appendix 'C' III. Statistical analysis of the yield data reveals that the treatments are *not significant*. The crop picked from the net plot is 1932.33 lb. as against 791.91 lb. recorded last year. Treatment A (Control) has recorded the highest yield, and the Treatment D (60:30:40) the least. No particular treatment has so far recorded consistently good yields.

2.2.3. *N.P.K. Trials with Constant Levels of N.P.K., but with Varying Sources of Nitrogen:* This experiment, laid out in 1953, was continued. The yield data is presented in Appendix 'C' IV. The plots were sprinkled in January and followed up again in February. Regular blossom showers were received in April. The blossom was good and uniform.

2.2.3.1. Statistical analysis of the yield data reveals that the treatments are *not significant*. Treatment D (Urea) has recorded high yield, while the Treatment A (Chilean Nitrate) has recorded the least. It is particularly interesting to note that the Treatment A (Chilean Nitrate) has been consistently recording low yields with the exception of last year's crop.

2.2.4. *N.P.K Trials with Varying Levels of Phosphorus and Potassium, and Constant Levels of Nitrogen (17-acre Manurial Experiments—1954 Series):* This experiment, started in 1954, was continued. The yield data are presented in Appendix 'C' V. Statistical analysis of the yield data reveals that the treatments are *not significant*. Treatment D (80:30:40) has recorded comparatively better yields than the rest of the treatments. This is the second crop picked from this experiment. The plants are yet to stabilize as they are still young.

2.2.5. *N.P.K. Trials with Varying Levels and Combinations (Arabica Manurial Experiment at the Coffee Research Sub-Station, Chethalli):* This experiment, laid out in 1952, was continued. The yield record is presented in Appendix 'C' VI. Statistical analysis of the yield data reveals that the treatments are *not significant*. The yield is varying from year to year. However, it is seen that, there appears to be a good response to yield, with increase in Phosphorus and Potassium applications with adequate Nitrogen application.

2.2.6. *Test Scale Trial at Coffee Research Sub-Station, Chethalli:* This experiment was continued and the details of the experiment have been furnished in the previous reports. The yield data from the experimental plot are furnished below:

Treatments	Yield of ripe cherry in pounds, calculated to the acre		
	Block I N applied in 2 equal doses, P and K in two equal doses	*Block II* N applied in 3 equal doses, P and K in two equal doses	Mean
** N_1	4052	2390	3221
N_2	3751	4394	4073
N_3	4649	5243	4946
N_4	5838	3444	4641
N_2P..... (Average of 3 plots)	4836	5125	4980
N_2PK (Average of 2 plots)	4583	5138	4860

** N_1: 40 lb. Nitrogen/acre; N_2: 60 lb. Nitrogen/acre;
N_3: 80 lb. Nitrogen/acre; N_4: 100 lb. Nitrogen/acre;
N_2P: 60 lb. Nitrogen + 30 lb. Phosphorus to the acre;
N_2PK: 60 lb. Nitrogen + 30 lb. Phosphorus + 40 lb. Potassium to the acre.

2.2.6.1. From the data presented above, it is seen that, in general, application of Nitrogen in 3 split doses, and Phosphorus and Potassium in 2 equal doses has recorded high yields this season. This is in accordance with previous observation with the exception of last year in which case application of Nitrogen, Phosphorus and Potassium in 2 split doses had recorded high yields.

2.3. *Field Trials to find out the Maximum Dose of Nitrogen and the Role of Phosphorus and Potassium in Nitrogen Utilisation:*

2.3.1. This trial, started in the Coffee Research Station in May 1956, was continued. The yield record of the harvest is presented in Appendix 'C' VII. It is seen from the statistical analysis of the yield data that both the main and sub-treatments are *not significant*. Among the main treatments, Treatment F (100:45:60) has recorded the highest yield this year, and Control (no manure), the least. It is interesting to note that, out of the four years' data available on this experiment, Treatment F (100:45:60) has consistently recorded high yields in 2 seasons and has almost been in the forefront in the rest of the seasons. For old coffee, this may perhaps indicate that it is not economical to apply more than 100:45:60 NPK. Among the sub-treatments, NPK only has recorded higher yield than the others, but it is varying from year to year.

2.4. *Effect of Different Sources of Nitrogen on the Growth and Yield of Mature Coffee:*

2.4.1. This experiment, started in April 1956 in the Shigode Estate near the Coffee Research Station, was continued. The yield record of the experiment is presented in Appendix 'C' VIII. Statistical analysis of the yield data shows that the treatments are highly *significant*. Treatment D (Urea) is *significantly superior* to the rest of the treatments which are *on par*. Treatment D (Urea) has been consistently recording high yields for the last 3 seasons. It is interesting to note that the Nitrate sources have been recording poor yields since the start of the experiment. However, Treatment F (Ammonium Sulphate Nitrate) has recorded a fairly good yield this season.

2.5. *Manurial Experiments on Robusta Coffee:*

2.5.1. *N.P.K. Trials with Varying Levels and Combinations at the Coffee Research Sub-Station, Chethalli:* This trial, started in 1954, was continued. The yield record of the experiment is presented in Appendix 'C' IX. Statistical analysis of the yield data reveals that the treatments are *not significant*. It is seen from the yield data that there is an increase in yield with the increase in the application of Phosphorus and Patassium, with adequate Nitrogen. This observation is in conformity with earlier observations.

2.5.2. *Field Manurial Trials on Robusta Coffee:* These trials started in Wynaad and Saklespur Zones in 1955, were continued. The yield data of the plots for 1960-61 is presented in Appendix 'C' X. The yield data of all the trials have been statistically analysed and the results are summarised below.

2.5.2.1. Both the main and sub-treatments are *not significant* in the estates in Wynaad Zone, while in Sulgode Estate in Saklespur Zone, the main treatments are *not significant*, but the sub-treatments are highly *significant*. Main Treatment B (60 lb. N) has recorded high yields in 3 estates out of 5 in which the trials are under progress. It is interesting to note that the Treatment B (60 lb. N) has recorded high yields in Pathripara and Chellote Estates for two consecutive seasons. In Chellote, Treatment B (60 lb. N) has consistently recorded high yields for the last 3 seasons.

2.5.2.2. Sub-treatments in Sulgode Estate are highly *significant*. They are *significant both at 5% and 1% levels*. Treatment NP has recorded high yield and is *superior* to the other treatments. In general, it is seen that the Treatment NP has recorded high yields in 3 out of the 5 estates. It may be mentioned that the treatments having P and K have also consistently recorded high yields.

2.5.2.3. Yield data from the Treatments NP and NPK at different levels of Nitrogen as percentage mean of N_1 and N_2 have been presented in Appendix 'C' XI. An examination of the data reveal the following points:

(1) At a basic level of 30 lb. Phosphorus and 40 lb. Potassium to the acre, highest yields have been recorded at Nitrogen level of 100 lb. in all the 5 estates;

(2) At 60 lb. and 80 lb. levels of Nitrogen, increased yields were recorded in the case of Treatment NP in 2 out of 4 cases, whereas at 40 lb. and 100 lb. Nitrogen level, increased yields were recorded in the case of Treatment NPK in the remaining 2 cases.

2.5.3. *Modified Manurial Trials on Robusta Coffee:*

Series I:

2.5.3.1. These field trials, started in Wynaad, Malabar, Coorg and Mysore in 1956, were continued. The yield data from these trials are presented in Appendix 'C' XII.

2.5.3.2. Statistical analysis of the yield data of these trials reveals that the treatments are *not significant* in any of the estates in which the trials are under progress. Treatment B (60:30:40) has recorded high yields in 2 out of 4 estates. It may be mentioned that the Treatment B (60:30:40) had recorded high yields last year also.

Series II:

2.5.3.3. These trials, started in 1956, were continued in Wynaad, Malabar and Mysore. The yield data are presented in Appendix 'C' XIII.

2.5.3.4. Statistical analyses of the yield data of these experiments show that the treatments are significant only in Maniangode Estate. All the treatments in Maniangode Estate are superior to Treatment F (Control—No manure). Treatment E (60:45:60) has recorded high yields. Treatments E (60:45:60), D (0:45:60), C (60:45:60) and A (60:0:0) are all *on par*. Treatments were also significant last year in Maniangode Estate, but Treatment B (60:45:0) recorded high yield. The results are varying from year to year.

2.6. *Field Trials on the Effect of Minor Elements on the Growth and Yield of Coffee (Experiment with Chelates):*

2.6.1. This experiment, started in 1957 July, was continued. The details of the experiment have been furnished in the Eleventh Annual Report. Crop was allowed to set only on the brown wood last year, but this year the full crop was allowed both on the green wood and the brown wood. Treatment NaCu has recorded the highest pick, and the Treatment F (NPK) has recorded the least. There appears to be no visual differences in growth.

2.7. *Studies to find out the Maximum Economic Dose of Nitrogen Utilisation with and without Basal Dressing for Young Coffee (Experiment in 'O' Block):*

2.7.1. The details of the layout and the treatments have been furnished in the Twelfth Annual Report. Blossoms were rubbed off last year on the green wood and this year, it was allowed both on the brown wood and the green wood. The crop harvested this year forms the basic data. Treatment D (400:300:400) has recorded high yields and Treatment E (40:30:40), the least. The plants are still young and yet to establish.

2.8. *Experiments on the Response to Manuring of Coffee Seedlings in the Nursery:*

2.8.1. *N+P+K Trials with Varying Levels and Combinations:* This experi-

ment, described in detail in the Tenth Annual Report, was continued. Treatment $N_1P_2K_2$ (20:30:40) has recorded more yield than the rest of the treatments. Last year, Treatment $N_2P_2K_2$ (40:30:40) had recorded more yield than others. The plants have become pot bound and only 73 plants out of 81 have yielded the crop.

2.8.1.1. As mentioned in the previous report, Nitrogen deficiency was noticed in all the plants not receiving Nitrogen and this resulted in heavy defoliation. There was a slight recovery after the onset of rains. Phosphorus deficiency was also noticed on stray plants not receiving Phosphorus.

2.8.2. *Trials on the Effect of the Application of Minor Elements and Chelates on the Growth of Young Coffee (Pot Culture):* As mentioned in the previous Annual Report, plants treated with A (Es-min-el) continued to have a good growth. The blossom was rubbed off as the plants were still young.

3. Cultural Experiments:

3.1. *Studies on the Growth and Yield of Coffee in Relation to Shade Requirement—Hedge-row System of Planting:*

3.1.1. This experiment, started in 1953, was continued. This area was sprinkled first in January 1960 and was followed up again in February, with the regular blossom showers occurring in April. The plants responded well resulting in a fairly good blossom. Plants in the open again recorded a better crop than those under shade. The yield data, both in terms of cherry and clean coffee, are given below.

OPEN (Yield in lbs. calculated to the acre)		SHADE (Yield in lbs. calculated to the acre)	
	(84.3 Cwt.)		(63.7 Cwt.)
In terms of Cherry:	9,445.6	In terms of Cherry:	7,135.3
	(14.1 Cwt.)		(10.6 Cwt.)
In terms of Clean Coffee:	1,574.3	In terms of Clean Coffee:	1,189.2

This is the second successive year that plants in the open have recorded more crop than plants in the shaded region. The overall crop from this experiment from both shaded and open regions, is comparatively more than the previous crop. This may perhaps be attributed to the effects of sprinkling in right time, for the plants to tide over the moisture stress.

4. Observational Trials:

4.1. *Studies on the Response to Foliar and Soil Applications of Trace Elements for Coffee Plants Suffering from Deficiency of Minor Elements:*

4.1.1. This trial, started in Neranki Estate, Hirebyle P.O., in December 1959, was concluded in January 1961. The details of the trial have been furnished in the Fourteenth Annual Report. Observations from the trial indicated that the plants were suffering from zinc deficiency. This was confirmed by spectrophotometric determination of zinc in both the affected and improved plants. The results of the trial were again

extended to a larger area for confirmation. The plants improved and responded well to zinc sulphate foliar sprays at 0.25% concentration. This brings out that a certain amount of zinc deficiency exists in coffee, but the conditions may not be favourable as yet for the symptoms to become generally manifest.

4.2. *Studies on the Response to Foliar Application of Minor Elements for Coffee Plants having Malformations of Leaf and Twig and also Die-back:*

4.2.1. This trial was laid out in 'N' Block in April 1961, in the Coffee Research Station, on old coffee having both malformations and die-back. The details of the trial are presented below.

4.2.2. Ninety plants were selected in 'N' Block and two branches at random were tagged in each plant. Ten plants in a row were selected for each treatment with two rows of coffee in between each treatment serving as borders.

4.2.3. The following treatments are to be imposed four times a year, *i.e.*, April, June, October and February. The first and second sets of treatments were imposed in April and June respectively.

(1) A: Zn+Mn+Fe+Cu @ 4 lb. in 100 gallons of water.

(2) B: Solubor @ 1 lb. in 40 gallons of water.

(3) C: Plain water @ 1 gallon per plant.

(4) D: Zinc sulphate+Solubor @ 1 lb. each in 40 gallons of water.

(5) E: Magnesium sulphate @ 2 lb. in 40 gallons of water.

(6) F: Tracel @ 4 lb. in 100 gallons of water.

(7) G: Nu-iron @ 3 lb. in 100 gallons of water.

(8) H: Control (No treatment).

(9) I: Zinc sulphate @ 1 lb. in 40 gallons of water.

4.2.4. *Observations to be recorded:* Monthly observations on the tagged branches are to be recorded as follows: the number of nodes; number of leaves; and the length of the twig from the point where it is tagged. In addition to these, the following will also be recorded:

(1) Improvement on the affected bush;

(2) Condition of the new flush;

(3) Overall condition of the plant; and

(4) Crop position.

4.2.5. The observations recorded so far do not show any appreciable differences between the treatments. Observations are being continued.

LABORATORY

5. Work in the laboratory consisted mainly of analyses of plant and soil samples collected by the Division from the experimental plots and from the problem areas.

6. Studies on Foliar Feeding of Plant Nutrients:

6.1. To confirm the observations made in the Foliar Feeding Trials conducted in 1956-57 and also with a view to study the minimum time required for absorption and the pattern of absorption of nutrients, this trial was taken up again in March 1960. The details of the trial have been presented in the Tenth Annual Report.

6.2. The first pair of mature leaf samples from the apex were collected before and at shorter intervals after the application of treatments (2, 4, 8, 24 and 48 hours). The analytical data are presented in Appendix 'C' XIV.

6.3. The following points are noticed from the analytical data:

6.3.1. *Nitrogen:* In plants sprayed with a higher concentration of Urea (N_2), maximum absorption of Nitrogen took place between 4 and 8 hours after the application of the treatment. In those, treated with lower concentration of Urea (N_1), maximum absorption took place between 8 and 24 hours after the spray. Increase of leaf Nitrogen content was gradual in the case of plants treated with lower concentration. They showed an increase upto 24 hours and thereafter, there was not much of an increase. Increase in leaf Nitrogen was rapid in the case of plants treated with higher concentration of Nitrogen. Samples collected 8 hours after treatment recorded maximum increase. The Nitrogen values did not alter much in the subsequent sets collected 24 and 48 hours after the application of treatments.

6.3.2. *Organic Carbon:* Organic Carbon values varied very much in the different sets of leaves collected. This may perhaps be due to variation in the rates of assimilation and translocation, occurring during the different periods of the day, depending on the variations in factors such as temperature, light intensity and humidity. The fluctuations in Organic Carbon content are greater when compared with Nitrogen. Organic Carbon values decreased very much in the samples collected 24 hours after treatment.

6.3.3. *Carbon/Nitrogen:* The Carbon/Nitrogen ratio decreased, in the set collected 24 hours after the foliar application, indicating the efficient absorption of Nitrogen. It was lowest in plants sprayed with 1% Urea solution, indicating maximum absorption of Nitrogen. There was a sudden increase in the samples collected 48 hours after spray, except in the case of N_2, N_2K_2 and $N_2P_2K_2$, in which the increase was moderate. These treatments recorded lower Carbon/Nitrogen figures in samples collected at the end of 48 hours, when compared with the rest of the treatments. This may perhaps be due to the increase in the rate of absorption of Nitrogen, in these treatments.

6.3.4. *Phosphorus:* A decrease in the Phosphorus content was noticed in all leaf samples collected 2 hours after treatment. Maximum absorption took place between 24 and 48 hours after the foliar spray. There was a general increase in the Phosphorus content in the leaves collected 24 hours after the treatment, with the exception of the treatments N_2P_2, $N_1P_1K_1$ and $N_2P_2K_2$, in which increase in the Phosphorus content was noticed 8 hours after the treatment. A decrease in the Phosphorus content was noticed in the leaf samples collected from the Treatment—Control and Plain Water, at the end of 48 hours. In general, all Phosphorus treated plants (N_1P_1, N_2P_2, $N_1P_1K_1$ and $N_2P_2K_2$) showed an increase in the Phosphorus content, the highest

increase being in N_2P_2 and N_1P_1 at the end of 48 hours. There appears to be a negative correlation between the initial Phosphorus status and the amount of Phosphorus absorbed. The lower the initial Phosphorus content, the greater is the quantity of the Phosphorus absorbed. Absorption of the Phosphorus was slower and more pronounced than the Nitrogen.

6.3.5. *Potassium:* Leaf samples collected 4 hours after the application of the treatments showed an increase in the Potassium content in general. There was a gradual increase in the Potassium content in leaves collected from the Treatments N_2K_2 and N_1K_1 in the subsequent sets, whereas a sharp decrease was noticed in the others. The Potassium content of leaves increased again in the samples collected 48 hours after application. Increase in the Potassium content was more in all Potassium treated plots (N_1K_1, N_2P_2, $N_1P_1K_1$ and $N_2P_2K_2$) than in others. However, there were no significant differences in the Potassium content between the different treatments. Highest increase in the Potassium content was noticed in the Treatment—Control, at the end of 48 hours which could not be explained.

6.3.6. *Calcium:* There was a general decrease in the Calcium content of leaves collected from all the treated plants, 2 hours after the spray. The values increased gradually from the 2nd set onwards and increased slightly above the original level at the end of 48 hours. There appears to be a positive correlation between the Phosphorus and Calcium contents. There is a negative correlation between the Calcium and Potassium contents.

6.3.7. *General:* The increases and decreases of plant nutrient status in leaves may perhaps be due to the variation in the concentration of plant nutrients. When it is high in leaves, there is a tendency for it to move from the region of higher to lower concentration. When it is low in leaves due to rapid transpiration and translocation than what it is in the root region, there is a likelihood of plant nutrients moving towards the region of lower concentration, *i.e.*, leaves. Thus, the plant nutrient status is raised in the leaves.

6.3.7.1. Very little is known about the movement of nutrients in the plant. The variation of plant nutrients in leaves may perhaps be ascribed to the variation of concentration of plant nutrients in the root and shoot regions at different periods.

7. Studies on the Diurnal Variation of Plant Nutrients in Coffee Leaves:

7.1. With a view to study the Diurnal variation of plant nutrients in coffee, leaf samples were collected at hourly intervals and analysed in the laboratory. The details of the above study are given below:

(1) Leaf samples were collected on the longest day from Sun-rise to Sun-set, at hourly intervals.

(2) Collection of leaf samples were made on 3 staked plants of the same age and variety with an uniform growth to serve as replicates which were located in the same area.

(3) At the time of collection, the following meteorological observations were recorded in the area where the plants were located:

(a) Time, (b) Light intensity with EEL Lightmaster Photoeter, (c) Temperature, and (d) Relative humidity using Asman's Pschyrometer.

(4) Collection of leaf samples were confined to the 1st pair of mature leaves (4th or 5th pair from the apex). Each sample consisted of 12 pairs of leaves.

(5) The following constituents were proposed to be determined in the samples:

(a) Total Nitrogen—Water soluble, Nitrate and Nitrite Nitrogen, (b) Total Phosphorus, (c) Total Potassium, (d) Total Calcium, (e) Total Magnesium, (f) Organic Carbon, (g) Carbohydrates, and (h) Starch.

7.2. Leaf samples were collected at hourly intervals on the longest day having 14 hours, on three well-developed S.795 plants of the same age, with uniform growth located in the same area. Meteorological data were also recorded at hourly intervals during the sample collection.

7.3. Leaf samples, collected in alkathene bags, were quickly brought to the laboratory and were washed in 0.3 N Hydrochloric acid for 3 seconds. After washing in the acid, they were immersed in tap water and were taken out and washed with distilled water. They were wiped softly with non-absorbant cotton and immediately, the fresh weights of the samples were recorded. Leaf samples were then dried in an electric force draught oven and were ground in an Ato-mill, fixed with an 80-mesh sieve. Analyses were carried out with these samples, and the analytical data are presented in Appendix 'C' XV. The following points are noticed in the analytical data.

7.3.1. It is interesting to note that there does not appear to be any correlation between the Nitrogen content of the leaf and the Diurnal variation in temperature, light intensity and humidity. Fluctuation in leaf Nitrogen is small and follows an alternate increase and decrease pattern up to 10.00 a.m., and thereafter, there is a decrease in the Nitrogen content. The peak level of Nitrogen in leaf during the day is at 9.00 a.m., and is also fairly high at 4.00 p.m. in the afternoon. There is a slight fall in the Nitrogen content of the leaf at the end of the day when compared with that in the 1st set of leaves.

7.3.2. Organic Carbon values steadily increase as the Sun goes up and reaches the peak between 12.00 noon and 1.00 p.m., when the light intensity is maximum. However, there does not appear to be any direct correlation between the 2 factors. This gradual increase in the Organic Carbon with the Sun going up may perhaps be attributed to the rapid synthesis of Carbohydrates during the early part of the day. After attaining the peak level, the Organic Carbon shows a decrease and is stable towards the end of the day, when perhaps both the synthesis and translocation rates are equal. There is an increase in the Organic Carbon status towards the end of the day when compared with the 1st set of the day.

7.3.3. The Phosphoric acid content in leaves follows an alternate increase and decrease pattern. There appears to be a slight reduction in the Phosphoric acid status of the leaves towards the end of the day when compared with the first set of the day. The Phosphoric acid status attains two peaks, one between 11.00 a.m. and 12.00 noon, and the other at 3.00 p.m., when the atmospheric temperatures are fairly high. This may perhaps indicate a correlation between the temperature and the Phosphoric acid content, showing that the Phosphoric acid content increases with the rise in the temperature.

7.3.4. There appears to be no correlation between the Potassium content of the leaves and the Diurnal variation in temperature, light intensity and humidity. The peak value for the Potassium content in the leaves was noticed at 12.00 noon and thereafter it varied considerably with alternate increase and decrease. Towards the end of the day, there appeared to be a slight reduction in the Potassium content when compared with the first set.

7.3.5. The Calcium content in leaves fluctuated slightly during the day. It started increasing at 8.00 a.m. and reached a high value at 10.00 a.m., and thereafter, it decreased till 12.00 noon. It increased again between 1.00 p.m. and 3.00 p.m. and fell off towards the end of the day. There appears to be no correlation between the Calcium content in the leaves and the Diurnal variation in temperature, light intensity and humidity. A slight reduction in the Calcium content was noticed in the plants towards the end of the day. The Calcium content appears to increase when the light intensity increases and humidity decreases. Further work is under progress.

8. Studies on the Seasonal Variations of Plant Nutrients in Coffee:

8.1. To study the seasonal variations of plant nutrients in coffee in the differentially manured plots, leaves were collected at monthly intervals from the plants in the New Manurial Series. Leaves were collected from both the "Non-bearing" and "Bearing" branches during May, June, July, August, September, October and November, and only from the "Non-bearing" branches during December, January, February, March and April. Leaf collection was confined to the first pair of mature leaves. These were analysed in the laboratory for Nitrogen, Organic Carbon, Phosphorus, Potassium and Calcium. The analytical data are presented in Appendix 'C' XVI. The following points are noticed in the analytical data:

8.1.1. *Nitrogen:* The seasonal variations in Nitrogen do not follow a regular pattern. However, in general, it is seen that the Nitrogen content starts increasing from March and reaches the peak value in June. Thereafter, there is a gradual reduction in the Nitrogen content during July and August. It starts increasing again from September and reaches the peak in October-November, and thereafter there is a gradual decrease. Thus, there appears to be two peak periods, one in May-June, and the other in October-November. These peak periods may perhaps be attributed to the application of fertilisers in May and September-October, and the low Nitrogen values may be due to the leaching of salts during the monsoons. The peak periods in the Nitrogen content appears to stress the importance of the application of nitrogenous fertilisers in May and

also in September, indicating the heavy draw of plant nutrients from the soil. This would also indicate the need of applying Nitrogen in split doses to maintain a uniform adequate level of Nitrogen in the leaf. In general, leaves collected on "Bearing wood" contain more Nitrogen than those collected from the "Non-bearing" branches in the months of May, July, August and September, while the Nitrogen values are comparatively lower than those of leaves collected from the "Non-bearing" branches during the rest of the period till harvest.

8.1.2. *Organic Carbon:* Organic Carbon values in leaves, in general, increase gradually from March and reach the peak in June. There is a slight decrease during July and August and they increase again in September. There is a reduction in the Organic Carbon status in October, and in November, it suddenly increases and records the highest value for year. Thereafter, there is a decline. Thus, the two peak periods in the Organic Carbon status of the leaves are June and November.

8.1.2.1. Leaves collected from the "Bearing" branches recorded more Organic Carbon during May, June, September and October than those from the "Non-bearing" branches. During the rest of the period, it is comparatively lower in leaves from the "Non-bearing" branches. It is interesting to note that the Organic Carbon content in the leaves collected from the "Bearing" branches is generally high for most of the periods when the crop is on the plant.

8.1.3. *Carbon/Nitrogen:* Carbon/Nitrogen values are highest during June and lowest during January. After attaining the highest value in June, it decreases gradually till it reaches the lowest in January. When the crop is on the bush for most of the period till it is harvested, the Carbon/Nitrogen figures are fairly higher in the leaves collected from the "Bearing" branches than those from the "Non-bearing" branches.

8.1.4. *Phosphorus:* Leaves collected in March generally show a fairly high Phosphorus content in them. There is a gradual reduction in the Phosphorus content in subsequent sets collected from April and it appears to be lowest during June-July. From August, it increases again till it reaches the highest value in November. After attaining the highest value, there seems to be a decrease in the Phosphorus values in subsequent sets. In general, it may be mentioned that the Phosphorus values are high during March and November and low during the monsoons.

8.1.4.1. Phosphorus is generally higher in the leaves collected from the "Bearing" branches in June, July, August and October than those from the "Non-bearing" branches. It may be mentioned that the Phosphorus treated plots generally had higher Phosphorus content than the other plots. In general, it is noticed that the Phosphorus values are more in the leaves collected from the "Bearing" branches than those from the "Non-bearing" branches during the period when the crop was on the plants.

8.1.5. *Potassium:* The Potassium values in leaves are generally high in April and November and they are lowest in September. The Potassium decreases gradually from May onwards and reach the lowest value for the season in September. It is low throughout the monsoon. This may perhaps be due to the leaching of the salts in rain.

8.1.5.1. Leaves collected from the "Bearing" branches in May and July have a

higher Potassium content than those from the "Non-bearing" branches. Generally, it is seen that the Potassium content is more in the leaves from the "Non-bearing" branches than those from the "Bearing" branches.

8.1.6. *Calcium:* The Calcium values in leaves are generally high in March and thereafter, they decrease gradually until they reach the lowest in August for that season. From September, the Calcium values in the leaves steadily increase till they reach high values in November. After a general decrease in December, they increase again. In general, it may be said that the Calcium values are high during dry weather than in the wet weather.

8.1.6.1. The Calcium values are generally high in the leaves collected from the "Bearing" branches than those from the "Non-bearing" branches during the period when there is crop on the plant.

8.1.7. *General:* During the period when the crop is present on the bushes, it is noted, in general, that Nitrogen, Organic Carbon, Phosphorus and Calcium are higher in the leaves collected from branches having crop than in the leaves collected from those having no crop. However, Potassium is an exception to this as it is more in the leaves collected from the "Non-bearing" branches than those from the branches having crop.

8.1.7.1. With a view to obtain more information on the seasonal variation of plant nutrients in coffee, this study is being repeated and along with it the seasonal variation of plant foods in soils in the 'Differentially manured plots' are also being studied to establish, if any, a correlation between the foliar and soil nutrient status.

9. Analysis of Leaf Samples from Well-Established and Popular Station Selections:

9.1. With a view to study the differences, if any, in plant nutrient status of the leaves in well-established, popular Station Selections, leaves were collected from S.795, S.288 and S.334. The leaves were analysed for Total Nitrogen, Organic Carbon, Total Phosphorus, Total Potassium and Total Calcium. The analytical data are presented in Appendix 'C' XVII.

9.2. It is seen from the analytical data that, generally, the plant nutrients are low when compared with older coffees like Kent's and Coorg's.

10. Analyses of Leaves from Different Varieties of Coffee in the "World Collections" Plot in the Coffee Research Station:

10.1. With a view to study the plant nutrient status in the different varieties of coffee in the "World Collections" plot in the Coffee Research Station as against the established older coffees of India, *viz.*, Kent's and Coorg's, leaves were collected and analysed. The analytical data are presented in Appendix 'C' XVIII.

10.2. It is seen from the analytical data that the Nitrogen content is low (2.4%-2.8%) in the other varieties of coffee as compared to Kent's and Coorg's. Nitrogen in

S.795 is also low when compared with the Kent's and Coorg's. There appears to be no appreciable differences between the different varieties from the "World Collections" and Kent's, Coorg's and S.795 regarding Phosphoric acid. Potassium values are higher in the leaves of different varieties from the "World Collections" than in Kent's and S.795, but is almost on par with the Coorg's. Calcium in the different varieties from the "World Collections" are fairly high, whilst they are low in the Kent's, Coorg's and S.795, in the order mentioned.

11. Analysis of Leaves from the Arabica Manurial Trial Plots at Coffee Research Sub-Station, Chethalli:

11.1. Leaf samples from the Arabica Manurial Trial Plots at Chethalli were collected and analysed. The analytical data reveal that plant nutrients are well-supplied in the leaves in all the plots.

ADVISORY

12. Soil and leaf samples collected from Srinivasa Estate, Saklespur, Chandragiri Estate, Chikmagalur, and Santaghery Estate, Coorg, were analysed and suitable advice tendered.

13. During the year under report, a case of zinc deficiency was detected in Neranki Estate by an 'Observational Trial' and was confirmed by the Spectrophotometric determination of zinc in the affected and improved plants.

14. Flow of Water from the Sub-Soil Drains from the Manurial Series:

14.1. The sub-soil drains in the new manurial series plots, which commenced discharging water from August 3, 1960 had discharged only 6,38,296 gallons of water by the 14th of August 1960 when they finally stopped. This is the lowest discharge for the last three years. The drains again started discharging later and were active only for a short time.

14.2. The drains started discharging from the 4th of July 1961 when the total rainfall had reached 59.50″. It is computed that 27,91,956 gallons of water had flown through the drains upto the 31st of July 1961.

15. The number of determinations carried out in the Division during the year are as follows:—

1	Moisture	1,276
2	Loss on Ignition	28
3	Insolubles	29
4	pH	349
5	Total Nitrogen	1,551
6	Nitrate Nitrogen	15
7	Organic Carbon	1,431

8	Total Phosphorus	977
9	Total Potassium	889
10	Total Sesquioxides	46
11	Total Calcium	934
12	Total Magnesium	120
13	Manganese	20
14	Iron	20
15	Zinc	106
16	Available Phosphorus	32
17	Available Potassium	41
18	Available Calcium	24
19	Water soluble Phosphorus	2
20	Total Solids in Drain Water	6
21	Mercury	2
22	Total Magnesium Oxide	18
23	Total Ash	165
24	Ammoniacal Nitrogen	5
25	Mechanical Analysis	130
26	Sieve Analysis of Rock Phosphate	8
27	Soil Tests	269
28	Tissue Tests	300
	Total	8,793

16. Experiments at the Coffee Research Sub-Station, Chethalli, Coorg:

(1) NPK Trials with varying levels and combinations on Arabica.

(2) NPK Trials with varying levels and combinations on Robusta.

(3) Exploratory Test Scale Observational Trial on Arabica with varying doses of Nitrogen and constant levels of Phosphorus and Potassium.

B. R. ANANTH,
Assistant Chemist

Studies on the Essential Requirements of Plant Foods NPK for Coffee in Relation to Improvement in Yield — New Manurial Series: Yield Record and Percentage of Floats in the Harvest

Area of experimental plot: 76 Cents

No. of plants per sub-plot: 5 × 8 = 40 (upto January 1955)

No. of plants per sub-plot: 5 × 4 = 20 (from January 1955)

Layout: Latin square

Treatments: 5

Spacing: Along the rows = 10'

Along diagonal = 7

Started: 1937

Replications: 5

Annual rate of manuring: Nitrogen 80 lb. to the acre in three equal doses.

Phosphoric acid 45 lb. to the acre in two equal doses.

Potash 60 lb. to the acre in two equal doses.

Year	Particulars	Average yield of ripe cherry in lb. and clean coffee in cwt. calculated to the acre and percentage of floats in the harvest — TREATMENTS					Standard error as % of gen. mean	Critical difference P= 0.05	Significant or not	Conclusions
		A N	B NP	C NK	D NPK	E Control				
1960	Cherry	340	338	411	457	136	2.56	268	No	D C A B E
1961	Cherry	5,254	6,480	5,069	5,943	4,178	7.01	1,162	Yes	B D A C E
1960	Clean Coffee	0.48	0.48	0.68	0.68	0.22	20.04	0.31	Yes	D C B A E
1961	Clean Coffee	7.82	9.20	7.34	8.70	5.78	7.80	1.87	Yes	B D A C E
1960	Percentage of floats by weight	14.58	12.00	16.26	13.54	16.48	15.60	7.29	No	E C A D B
1960	Percentage of floats by volume	19.18	20.34	21.20	18.20	25.34	20.23	12.99	No	E C B A D
1961	Percentage of floats by weight	12.08	12.12	14.16	12.16	12.98	8.38	3.28	No	C E D B A
1961	Percentage of floats by volume	12.50	11.98	13.70	12.00	13.08	10.09	3.94	No	C E A D B

APPENDIX 'C'—II

NPK Trials with Varying Levels of NPK — Fundamental Manurial Experiments in the pH Cisterns— Yield Record

Area of Experimental plot: 25 Cents

No. of plants per sub-plot: 1

Layout: Latin square

Treatments: 6

Spacing: 7½'

Started: 1950

Replications: 6

Annual rate of manuring:

A: 20 lb. Nitrogen +30 lb. Phosphoric acid +40 lb. Potash to the acre.
B: 30 „ „ +30 „ „ „ +40 „ „ „ „
C: 45 „ „ +30 „ „ „ +40 „ „ „ „
D: 30 „ „ +45 „ „ „ +40 „ „ „ „
E: 30 „ „ +45 „ „ „ +60 „ „ „ „
F: 45 „ „ +67.5 „ „ „ +90 „ „ „ „

Year	Particulars	Average yield of ripe cherry and clean coffee in lb. per plot and percentage of floats						Conclusions
		TREATMENTS						
		A	B	C	D	E	F	
1960	Cherry	4.19	4.93	6.17	5.82	5.97	5.51	C E D F B A
1960	Clean Coffee	0.58	0.87	0.92	0.84	0.73	0.79	C B D F E A
1960	Floats by weight	26.83	23.33	23.16	24.33	25.33	27.00	F A E D B C
1960	Floats by volume	25.83	23.50	29.16	22.83	28.83	27.66	C E F A B D

Studies on the Effect of Varying Doses of Nitrogen with Constant Levels of P_2O_5 and K_2O on the Growth and Yield of Coffee — Yield Record

Area of Experimental plot: 1.13 acres

Layout: Latin square

No. of plants per sub-plot: Gross: $7 \times 7 = 49$

Nett: $5 \times 5 = 25$

Treatments: 5

Replications: 5

Variety of coffee: Nett: Kent's Clones

Inner border rows: Kent's seedlings

Guard rows: S-983 seedlings

Annual rate of manuring:

A: Control—No manure.

B: 80 lb. Nitrogen, 30 lb. Phosphoric acid, 40 lb. Potash to the acre per annum.

C: 100 „ „ 30 „ „ „ 40 „ „ „ „

D: 60 „ „ 30 „ „ „ 40 „ „ „ „

E: 40 „ „ 30 „ „ „ 40 „ „ „ „

Year	Particulars	Average yield of ripe cherry in lb. calculated to the acre					Standard error as % of gen. mean	Critical difference P=0.05	Significant or not	Conclusions
		TREATMENTS								
		A	B	C	D	E				
1960	Ripe Cherry	1,152	1,121	2,223	1,773	1,332	21.72	1,018	No	C D E A B
1961	Ripe Cherry	4,103	4,090	3,873	2,834	3,806	21.54	1,437	No	A B C E D

APPENDIX 'C' — IV

Studies on the Effect of Different Sources of Nitrogen on the Growth and Yield of Coffee — Yield Record

Area of Experimental plot: 0.98 acre

No. of plants per sub-plot: Gross: $7 \times 6 = 42$

Nett: $5 \times 4 = 20$

Layout: Latin square

Treatments: 5

Spacing: 6′ × 6′

Replications: 5

Shade: Natural mixed shade

Planted: 1953

Annual rate of manuring: Nitrogen 80 lb. to the acre applied in 3 doses—1) Pre-blossom 20 lb., 2) Post-blossom 20 lb., and 3) Post-monsoon 30 lb.

Phosphoric acid 30 lb. to the acre.
Potash 40 lb. to the acre.
} To be applied in in two equal doses (Pre-blossom and Post-monsoon).

Treatments:

A: Required quantity of Nitrogen applied as Chilean Nitrate.

B: Control (no manure).

C: Required quantity of Nitrogen applied as Calcium Ammonium Nitrate.

D: „ „ „ as Urea.

E: „ „ „ as Ammonium Sulphate.

Year	Particulars	Average yield of ripe cherry in lb. calculated to the acre — TREATMENTS					Standard error as % of gen. mean	Critical difference P=0.05	Significant or not	Conclusions
		A	B	C	D	E				
1960	Ripe Cherry	1,764	774	906	1,074	2,538	27.74	1,226	No	E A D C B
1961	Ripe Cherry	2,916	4,666	4,777	5,569	4,765	9.76	1,819	No	D C E B A

Studies on the Effect of Varying Levels of Phosphoric Acid and Potash with Constant Level of Nitrogen on the Growth and Yield of Arabica Coffee — Yield Record for the Year 1960-61

Area of Experimental plot: 1 acre

No. of plants per sub-plot: Gross: $7 \times 5 = 35$

Nett: $5 \times 3 = 15$

Layout: Simple Randomized

Treatments: 6

Spacing: 6′ × 6′

Replications: 4

Shade: Natural mixed shade

Planted: July 1954

Treatments: A: 80 lb. Nitrogen only to the acre.

B: 80 lb. Nitrogen +45 lb. Phosphoric acid +60 lb. Potash to the acre.

C: „ „ +45 „ „ +40 „ „ „

D: „ „ +30 „ „ +40 „ „ „

E: „ „ +30 „ „ +60 „ „ „

F: Control—No manure.

Year	Particulars	Average yield of ripe cherry in lb. calculated to the acre — TREATMENTS						Standard error as % of gen. mean	Critical difference P=0.05	Significant or not	Conclusions
		A	B	C	D	E	F				
1960	Ripe Cherry	2,782	1,950	2,312	2,980	2,396	2,052	17.65	1,538	No	D A E C F B
1961	Ripe Cherry	2,225	2,155	1,105	2,585	2,081	1,749	6.82	1,657	No	D A B E F C

APPENDIX 'C'—VI

NPK Trials with Varying Levels and Combinations (Arabica Manurial Experiments) at the Coffee Research Sub-Station, Chethalli, Coorg Yield Data 1960-61

Area of experimental plot: 2.28 acres.

No. of plants per sub-plot:

Gross: $7 \times 7 = 49$.

Nett : $5 \times 5 = 25$.

Variety of coffee: S-446 2nd generation.

Terraced and planted: August 1952.

Layout: Factorial design $4 \times 2 \times 2$.

Replications: 3.

Planted: $6\frac{1}{2}' \times 6\frac{1}{2}'$.

Shade: Natural mixed shade.

First manuring: May 1953.

Treatments:

Nitrogen at 4 levels: N_0, N_1, N_2 and N_3.

$N_0 = 0$ lb. N ; $N_1 = 60$ lb. N ; $N_2 = 90$ lb. N ; $N_3 = 120$ lb. N ; per acre.

Phosphoric acid at 2 levels: P_0 and P_1.

$P_0 = 0$ lb. P_2O_5; $P_1 = 30$ lb. P_2O_5; per acre.

Potash at 2 levels: K_0 and K_1.

$K_0 = 0$ lb K_2O; $K_1 = 40$ lb. K_2O; per acre.

Tables of mean yields in lb. per plant

	N_0	N_1	N_2	N_3	Mean	
P_0	25.90	35.84	24.31	31.48	4.90	
P_1	27.21	27.49	33.78	29.36	4.91	S.E. = 0.31
Mean	4.43	5.28	4.84	5.07		
			S.E. = 0.44			

	N_0	N_1	N_2	N_3	Mean	
K_0	28.75	30.90	27.17	27.88	4.78	
K_1	24.36	32.43	30.92	32.96	5.03	S.E. = 0.31
Mean	4.43	5.28	4.84	5.07		
			S.E. = 0.44			

	P_0	P_1	Mean	
K_0	59.78	54.92	4.78	
K_1	57.75	62.92	5.03	S.E. = 0.31
Mean	4.90	4.91		
		S.E. = 0.31		

None of the factors is significant.

Field Trials to find out the Maximum Economic Dose of Nitrogen and the Role of Phosphates and Potash in Balancing the Nitrogen Utilization — Yield Record

Layout: Randomized

Treatments: Main: 6

Started: May 1956

Sub: 4

Shade: Natural mixed shade

Spacing: 5′ × 5′

Treatments:

Replications: 3

Main: 6—with 6 levels of Nitrogen from 0 lb. to 800 lb. to the acre annually with and without Phosphoric acid and Potash.

A: 50 lb. Nitrogen + 30 lb. Phosphoric acid + 40 lb. Potash to the acre.

B: 800 „ „ +360 „ „ „ +480 „ „ „

C: 200 „ „ + 90 „ „ „ +120 „ „ „

D: 0 „ „ + 0 „ „ „ + 0 „ „ „

E: 400 „ „ +180 „ „ „ +240 „ „ „

F: 100 „ „ + 45 „ „ „ + 60 „ „ „

Sub-Treatments: 1: Nitrogen with Phosphoric acid and Potash.

2: As in (one) + basal dressing of lb. of finely ground Rock Phosphate per plant applied at the commencement of the experiment.

3: Nitrogen only + basal dressing of Rock Phosphate applied as above.

4: Nitrogen only.

Time and method of application: 50 lb. Nitrogen level given in two equal doses in March and October while all the rest are given in four equal doeses in March, May, August and October; applied as a broad band within the drip circle of each plant under the leaf mulch.

Main treatments	Yield of ripe cherry in lb. per plot of 9 plants (totals of 3 replications)				Mean of main treatments	Standard error		Critical difference as P = 0.05		Significant or not		Conclusions
	Sub-treatments					Main treatments	Sub-treatments	Main treatments	Sub-treatments	Main treatments	Sub-treatments	
	1	2	3	4								
1960—												
A	28.5	22.3	14.9	18.4	7.01							
B	27.7	29.5	24.7	22.6	8.71							
C	22.6	19.0	16.8	18.1	6.38	4.37	2.11	4.07	1.37	No	Yes	Main: B F D A E C
D	24.9	18.0	20.3	21.0	7.02							
E	23.9	17.6	21.0	16.1	6.72							Sub: 1 2 3 4
F	27.5	18.3	19.9	19.8	7.13							
Mean of Sub-Treatments	8.62	6.93	6.53	6.44								
1961—												
A	46.8	31.3	40.5	38.3	13.07							
B	55.3	29.7	34.0	37.8	13.07							
C	31.5	37.1	33.7	24.5	10.57	0.26	0.21	0.58	0.42	No	No	Main: F A B C E D
D	31.3	29.4	33.1	23.2	9.75							
E	40.1	27.1	18.4	35.4	10.00							Sub: 1 3 4 2
F	34.0	36.0	53.5	34.6	13.17							
Mean of Sub-Treatments	13.27	10.59	11.84	10.76								

Studies on the Effect of Different Sources of Nitrogen on the Growth and Yield of Mature Yielding Coffee — Yield Record

Locality: Shigode Estate

Area of Experimental Plot: 1.5 acres

No. of plants per sub-plot: Gross: $7 \times 10 = 70$

Nett: $5 \times 8 = 40$

Spacing: $5' \times 5'$

Layout: Latin square

Treatments: 6

Replications: 6

Shade: Natural mixed shade

Started: 1956

Annual rate of manuring: Nitrogen 80 lb. to the acre applied in three doses.
Phosphoric acid 45 lb. to the acre applied in two equal doses.
Potash 60 lb. to the acre applied in two equal doses.

Treatments: A: Control—No manure.
B: Required quantity of Nitrogen applied as Calcium Ammonium Nitrate.
C: " " " as Ammonium Sulphate.
D: " " " as Urea.
E: " " " as Chilean Nitrate.
F: " " " as Ammonium Sulphate Nitrate.

Year and particulars		Average yield of ripe cherry in lb. calculated to the acre — TREATMENTS						Standard error as % of gen. mean	Critical difference P = 0.05	Significant or not	Conclusions
		A	B	C	D	E	F				
1960	Ripe Cherry	2,624	2,742	2,776	3,058	2,555	2,588	11.05	965	No	D C B A F E
1961	Ripe Cherry	2,423	2,331	2,580	3,593	2,445	2,716	4.87	385	Yes	D F C E A B

APPENDIX 'C' — IX

NPK Trials with Varying Levels and Combinations (Robusta Manurial Experiments) at the Coffee Research Sub-Station, Chethalli, Coorg Yield Data 1960-61

Area of experimental plot: 1.68 acre.
No. of plants per sub-plot:
Gross: $7 \times 6 = 42$.
Nett : $5 \times 4 = 20$.
Shade: Natural mixed shade.

Layout: Factorial design $4 \times 2 \times 2$.
Replications: 3.
Planted: Sept. 1954.
Planted: $13' \times 13'$.

Treatments:

Nitrogen at 4 levels: N_0, N_1, N_2 and N_3.
$N_0 = 0$ lb. N ; $N_1 = 60$ lb. N ; $N_2 = 90$ lb. N ; $N_3 = 120$ lb. N ; per acre.
Phosphoric acid at 2 levels: P_0 and P_1.
$P_0 = 0$ lb. P_2O_5 ; $P_1 = 45$ lb. P_2O_5 ; per acre.
Potash at 2 levels: K_0 and K_1.
$K_0 = 0$ lb. K_20 ; $K_1 = 60$ lb. K_20 ; per acre.

Tables of mean yields in lb. per plant

	N_0	N_1	N_2	N_3	Mean	
P_0	17.30	23.40	21.51	17.28	3.31	
P_1	20.56	18.40	27.20	21.01	3.63	S.E. = 0.34
Mean	3.16	3.48	4.06	3.19		
			S.E. = 0.48			

	N_0	N_1	N_2	N_3	Mean	
K_0	19.12	18.37	26.31	19.45	3.47	
K_1	18.74	23.43	22.40	18.84	3.48	S.E. = 0.34
Mean	3.16	3.48	4.06	3.19		
			S.E. = 0.48			

	K_0	K_1	Mean	
P_0	42.09	37.40	3.31	
P_1	41.16	46.01	3.63	S.E. = 0.34
Mean	3.47	3.48		
		S.E. = 0.34		

Field Manurial Trials in Private Estates on Robusta — Yield Record

Treatments: Main: 4
Sub: 4

No. of plants per sub-plot: Gross: 7 × 6 = 42
Nett: 5 × 4 = 20

Layout: Randomized split plot

Shade: Natural mixed shade

Started: 1955

Main Treatments:

A: Nitrogen at 40 lb. to the acre per annum.

B: „ 60 „ „

C: Nitrogen at 80 lb. to the acre per annum.

D: „ 100 „ „

Sub-Treatments:

N_1 : The required quantity of Nitrogen applied in two equal doses; once in the pre-blossom and once in the post-monsoon periods.

N_2 : The required quantity of Nitrogen applied in three doses; once in the pre-blossom, once in the pre-monsoon and once in the post-monsoon periods.

NP : The required quantity of Nitrogen applied as above (N_2)+30 lb. Phosphoric acid to the acre applied in two equal doses; once in the pre-blossom and once in the post-monsoon periods.

NPK : As in NP above +40 lb. Potash to the acre applied in two equal doses; once in the pre-blossom and once in the post-monsoon periods.

Main Treatments	Yield of ripe cherry in lb per plant (totals of replications)				Mean of main treatments	Standard error		Critical difference P=0.05		Significant or not		Conclusions
	Sub-Treatments											
	N_1	N_2	NP	NPK		Main plots	Sub-plots	Main treatments	Sub-treatments	Main treatments	Sub-treatments	
Sulgode Estate, Saklespur. Zone: Mysore. Spacing: 10′ × 10′. Replications: 3.												
1960—												
A	33.6	34.6	29.3	23.0	10.0							
B	26.3	28.6	26.7	38.1	10.0							Main: C D A B
C	37.4	35.8	39.9	44.1	13.1	3.25	3.32	3.25	2.79	No	No	
D	33.2	30.5	32.2	41.8	11.5							Sub: NPK N_1 N_2 NP
Mean of Sub-Treatments	10.9	10.8	10.7	12.2								

Main Treatments	Yield of ripe cherry in lb. per plant (totals of replications)				Mean of main treatments	Standard error		Critical difference P=0.05		Significant or not		Conclusions
	Sub-Treatments											
	N_1	N_2	NP	NPK		Main plots	Sub-plots	Main treatments	Sub-treatments	Main treatments	Sub-treatments	
1961—												
A	48.1	55.3	52.8	48.5	17.1							
B	34.1	54.2	64.3	43.5	16.3							Main: A B D C
C	39.4	32.3	54.4	35.5	13.5	3.19	2.33	3.19	0.69	No	Yes	
D	33.8	60.7	51.6	51.1	16.4							Sub: NP N_2 NPK N_1
Mean of Sub-Treatments	13.0	16.9	18.6	14.9								
Chellote Estate, Kalpetta, Wynaad. Spacing: 10′ × 10′. **Replications:** 2.												
1960—												
A	9.8	7.3	7.9	9.4	4.3							
B	7.4	8.8	8.7	10.7	4.5							Main: B A C D
C	6.7	7.7	8.7	7.3	3.8	0.99	0.76	1.21	0.78	No	No	
D	6.4	5.8	7.5	6.2	3.2							Sub: NPK NP N_1 N_2
Mean of Sub-Treatments	3.8	3.7	4.1	4.2								
1961—												
A	27.8	29.7	21.8	32.8	14.0							
B	27.5	34.0	30.9	23.3	14.5							Main: B D A C
C	21.0	26.1	28.8	31.8	13.4	3.26	1.84	10.38	4.01	No	No	
D	33.5	23.9	27.8	30.2	14.4							Sub: NPK N_2 N_1 NP
Mean of Sub-Treatments	13.7	14.2	13.6	14.8								
North Carolina Estate, Kalpetta, Wynaad. Spacing: Replications I & II 10′ × 10′; Replication III 9′ ×9′. **Replications:** 3.												
1960—												
A	9.1	7.6	6.9	9.0	2.7							
B	7.3	8.1	9.1	6.9	2.6							Main: C A B D
C	10.9	10.4	6.7	6.2	2.9	1.53	0.57	1.52	0.48	No	No	
D	7.6	6.0	7.9	8.0	2.5							Sub: N_1 N_2 NP NPK
Mean of Sub-Treatments	2.9	2.7	2.6	2.5								

APPENDIX 'C' — X (Contd.)

Main Treatments	Yield of ripe cherry in lb. per plant (totals of replications)				Mean of main treatments	Standard error		Critical difference P=0.05		Significant or not		Conclusions
	Sub-Treatments					Main plots	Sub-plots	Main treatments	Sub-treatments	Main treatments	Sub-treatments	
	N_1	N_2	NP	NPK								
1961—												
A	37.3	27.7	30.8	34.6	10.9							
B	40.6	38.2	34.8	36.2	12.5							Main: C D B A
C	45.1	45.1	42.7	35.0	14.0	2.23	1.28	4.78	3.60	No	No	
D	39.2	43.0	51.7	57.9	16.0							Sub: NPK N_1 NP N_2
Mean of Sub-Treatments	13.5	12.8	13.3	13.6								
Krishna Estate, Kalpetta, Wynaad. Spacing: 9′ × 9′. Replications: 3.												
1960—												
A	8.4	12.0	10.9	13.2	3.7							
B	10.0	15.0	10.9	13.9	4.2							Main: C B D A
C	11.7	13.6	15.0	13.5	4.5	1.07	1.02	1.07	0.85	No	No	
D	10.7	11.0	11.1	13.6	3.9							Sub: NPK N_2 NP N_1
Mean of Sub-Treatments	3.4	4.3	3.9	4.5								
1961—												
A	33.3	32.0	35.9	27.6	10.6							
B	40.8	25.5	43.5	39.0	12.6							Main: B C A D
C	23.3	40.8	34.1	30.2	11.0	0.88	1.36	1.88	3.84	No	No	
D	25.4	31.2	27.4	34.2	9.8							Sub: NP NPK N_2 N_1
Mean of Sub-Treatments	10.5	10.5	12.2	10.9								
Pathripara Estate, Kalpetta, Wynaad. Spacing: 9′ × 9′. Replications: 3.												
1960—												
A	19.0	16.6	26.8	12.8	6.3							
B	23.1	23.3	17.6	25.7	7.5							**Main: B D A C**
C	18.2	15.2	20.7	16.8	5.9	2.34	1.89	2.34	1.59	No	No	
D	19.0	25.1	22.1	21.5	7.3							Sub: NP N_2 N_1 NPK
Mean of Sub-Treatments	6.6	6.7	7.3	6.4								
1961—												
A	44.1	31.2	40.5	44.0	13.3							
B	41.2	33.3	33.1	44.0	12.8							**Main: B D A C**
C	36.3	26.2	36.1	25.3	10.3	1.36	1.34	2.91	3.77	No	No	
D	32.1	34.9	35.2	37.3	11.6							**Sub: NP N_2 N_1 NPK**
Mean of Sub-Treatments	12.8	10.5	12.2	12.5								

APPENDIX 'C' — XI

Field Manurial Trials in Private Estates — Robusta

Yield of Cherry Expressed as Percentage of the Means of N_1 and N_2

Treatments		Krishna	Pathripara	North Carolina	Chellote	Sulgode	Means of five estates
Main	Sub						
A: 40 lb. N_2	N	100.0	100.0	100.0	100.0	100.0	100.0
	40 lb. N_2 NP	111.6	107.5	94.8	76.0	102.2	98.4
	40 lb. N_2 NPK	85.8	116.6	106.8	117.5	93.8	104.1
B: 60 lb. N_2	N	100.0	100.0	100.0	100.0	100.0	100.0
	60 lb. N_2 NP	153.1	94.1	88.3	100.6	145.7	116.4
	60 lb. N_2 NPK	123.1	118.2	91.9	75.7	98.7	101.5
C: 80 lb. N_2	N	100.0	100.0	100.0	100.0	100.0	100.0
	80 lb. N_2 NP	101.6	115.7	94.6	122.3	151.5	117.1
	80 lb. N_2 NPK	90.0	77.7	77.7	135.2	99.0	95.9
D: 100 lb. N_2	N	100.0	100.0	100.0	100.0	100.0	100.0
	100 lb. N_2 NP	96.8	105.3	125.9	96.8	114.4	107.8
	100 lb. N_2 NPK	120.9	111.3	140.8	105.3	108.4	117.3

Modified Robusta Manurial Trials Laid Out in Private Estates — Series I — Yield Data

Layout: Latin square. **Treatments:** 6. **Replications:** 5. **Shade:** Natural shade. **Started:** 1956.

No. of plants per sub-plot: Nett: 5 × 4 = 20 with one common border row on either side and between each successive pair of sub-plots and a common guard row all round the plot.

Treatments:

A: 40 lb. Nitrogen, 30 lb. Phosphoric acid, and 40 lb. Potash to the acre per annum.
B: 60 „ „ 30 „ „ „ 40 „ „ „ „
C: 60 „ „ 45 „ „ „ 60 „ „ „ „
D: 80 „ „ 60 „ „ „ 80 „ „ „ „
E: 60 „ „ 60 „ „ „ 80 „ „ „ „
F: 40 „ „ 60 „ „ „ 80 „ „ „ „

A basal dressing of 10 cwt. of finely ground Rock Phosphate is applied broadcast and stirred into the top soil soon after marking out the plots during the commencement of the trial.

Time of application of fertilisers: Nitrogen applied in three doses; once in the pre-blossom, once in the post-blossom and once in the post-monsoon period. Phosphoric acid and Potash applied in two doses during the pre-blossom and post-monsoon periods.

Name of Estates	Average yield of ripe cherry in lb. calculated to the acre — TREATMENTS						Standard error as % of gen. mean	Critical difference P = 0.05	Significant or not	Conclusions
	A	B	C	D	E	F				
1960—										
Panchura Estate, Kalpetta, Wynaad	3,240	3,294	2,484	2,808	2,646	3,240	13.19	1,160	No	B F A D E C
Maniangode Estate, Kalpetta, Wynaad	2,322	2,268	2,862	2,322	2,862	2,430	7.76	563	No	E C F A D B
Huvinkadu Estate, South Coorg	3,264	2,992	2,992	2,448	3,604	2,856	13.33	1,206	No	E A C B F D
Bankal Estate, Mudigere	5,936	4,420	4,726	5,236	5,648	5,828	6.92	1,081	Yes	A F E D C B
Yemmegundi Estate, South Coorg	695	2,312	1,496	1,564	1,292	1,156	21.82	950	No	B D C E F A
1961—										
Panchura Estate, Kalpetta, Wynaad	3,111	2,923	3,147	3,703	3,174	3,004	7.73	726	No	D E C A F B
Maniangode Estate, Kalpetta, Wynaad	6,921	7,506	6,273	6,147	6,615	6,777	12.45	2,462	No	B A F E C D
Huvinkadu Estate, South Coorg	5,225	5,689	5,553	4,919	4,862	4,703	7.18	1,034	No	B C A D E F
Bankal Estate, Mudigere	4,873	4,409	4,001	3,899	4,647	5,123	8.89	1,176	No	F A E B C D
Yemmegundi Estate, South Coorg	4,937	4,774	4,508	4,624	4,508	4,726	6.67	921	No	A B F D C E

APPENDIX 'C' — XIII

Modified Robusta Manurial Trials Laid Out in Private Estates — Series II — Yield Data

Layout: Latin Square. **Treatments:** 6. **Replications:** 6. **Shade:** Natural mixed shade. **Started:** 1956.

No. of plants per sub-plot: Nett: $5 \times 4 = 20$ with one common border row on either side and between each successive pair of sub-plots and a common guard row all round the plot.

Treatments:

A: N only at 60 lb./acre applied as Ammonium Sulphate.
B: N as above +45 lb. P_2O_5 per acre applied as Hyper Phosphate Reno.
C: N as above +60 lb. K_2O/acre applied as Muriate of Potash.
D: P_2O_5 at 45 lb./acre +60 lb. K_2O/acre applied as Hyper Phosphate Reno and Muriate of Potash respectively.
E: As in treatment B above +60 lb. K_2O/acre applied as Muriate of Potash.
F: Control (no manure).

A basal dressing of 10 cwt. of finely ground agricultural lime-stone is to be applied broadcast and stirred into the top soil soon after marking out the plots during the commencement of the trial.

Time of application of fertilizers: Nitrogen applied in three doses during the pre-blossom, post-blossom and post-monsoon periods. P_2O_5 and K_2O applied in two equal doses during the pre-blossom and post-monsoon periods.

Name of Estates	Average yield of ripe cherry in lb. calculated to the acre — TREATMENTS						Standard error as % of gen. mean	Critical difference P = 0.05	Significant or not	Conclusions
	A	B	C	D	E	F				
1960—										
1 Panchura Estate, Kalpetta, Wynaad	2,986	2,500	2,576	2,954	2,673	1,631	7.02	653	Yes	A D E C B, F
2 Maniangode Estate, Kalpetta, Wynaad	2,468	2,511	1,982	2,333	2,446	1,334	8.24	666	Yes	B A E D C, F
3 Bankal Estate, Mudigere	3,808	4,012	3,672	3,332	3.604	3,740	9.59	1,047	No	B A F C E D
1961—										
1 Panchura Estate, Kalpetta, Wynaad	2,278	2,520	2,744	2,851	2,565	2,331	8.48	640	No	D C E B F A
2 Maniangode Estate, Kalpetta, Wynaad	4,914	6,696	6,030	6,084	6,462	3,402	9.95	1,647	Yes	E D C B A, F
3 Bankal Estate, Mudigere	2,425	3,049	2,811	2,176	2,924	2,720	14.47	1,149	No	B E C F A D

APPENDIX 'C'—XIV

Analytical Data of the Leaf Samples Collected from the Foliar Feeding Trials

Values on moisture free basis (average of 3 replications)

Sl. No.	Treatments	Total Nitrogen %						Organic Carbon %						Carbon/Nitrogen					
		*I Set	*II Set	*III Set	*IV Set	*V Set	*VI Set	I Set	II Set	III Set	IV Set	V Set	VI Set	I Set	II Set	III Set	IV Set	V Set	VI Set
1	N_1	2.616	2.494	3.459	3.592	4.073	3.434	46.41	42.79	49.82	43.89	38.99	44.05	17.44	17.18	14.50	12.22	9.58	12.92
2	N_2	2.935	2.439	3.758	3.812	3.802	3.834	48.22	40.91	46.92	43.33	38.85	44.95	16.44	17.16	12.40	11.37	10.27	11.76
3	N_1P_1	2.421	2.468	3.277	3.559	3.664	3.588	47.49	42.61	46.54	43.51	39.73	45.29	19.98	17.58	14.24	12.23	10.95	12.62
4	N_2P_2	2.287	2.500	3.541	3.664	3.692	3.732	48.76	42.17	47.35	43.25	39.69	45.04	21.35	17.15	13.40	11.79	10.79	12.08
5	N_1K_1	2.162	2.188	3.565	3.503	3.546	3.650	47.18	42.69	47.95	42.30	39.03	45.11	21.82	19.51	13.44	12.26	11.02	12.37
6	N_2K_2	2.344	2.349	3.288	3.723	3.930	3.909	47.66	40.65	46.00	43.12	40.37	44.14	20.49	17.65	13.99	11.59	10.27	11.31
7	$N_1P_1K_1$	2.315	2.204	3.456	3.725	3.481	3.728	49.60	37.53	46.44	43.35	38.66	44.82	21.32	17.03	13.46	11.66	11.11	12.10
8	$N_2P_2K_2$	2.440	2.359	3.520	3.615	3.767	3.739	48.96	36.12	45.16	42.38	38.43	44.41	20.12	15.54	13.76	11.74	10.26	11.83
9	Control	2.165	2.257	3.306	3.487	3.745	3.389	49.49	35.89	44.36	43.37	38.99	45.04	22.98	15.93	13.41	12.46	10.44	13.29
10	Plain water	2.056	2.082	3.363	3.175	3.757	3.674	49.85	38.89	48.35	43.08	39.32	45.27	23.08	18.68	14.30	13.50	10.55	13.83

* Please see next page.

APPENDIX 'C'—XIV (Contd.)

Sl. No.	Treatments	Total Phosphoric Acid %						Total Potassium %						Total Calcium %					
		*I Set	*II Set	*III Set	*IV Set	*V Set	*VI Set	I Set	II Set	III Set	IV Set	V Set	VI Set	I Set	II Set	III Set	IV Set	V Set	VI Set
1	N_1	0.472	0.379	0.373	0.375	0.402	0.424	2.346	2.538	3.042	2.914	2.942	2.885	1.112	0.822	0.723	1.043	1.237	1.153
2	N_2	0.453	0.356	0.430	0.413	0.401	0.496	2.633	2.568	3.266	3.071	2.944	3.114	1.096	0.808	0.838	0.994	1.193	1.142
3	N_1P_1	0.380	0.362	0.386	0.407	0.424	0.568	2.519	2.631	3.070	2.861	2.767	2.774	1.112	0.798	0.932	1.033	1.180	1.212
4	N_2P_2	0.450	0.354	0.381	0.458	0.401	0.608	2.579	2.456	3.046	2.722	2.780	2.913	1.074	0.760	0.775	1.000	1.125	1.111
5	N_1K_1	0.401	0.355	0.407	0.360	0.365	0.474	2.372	2.494	3.075	2.881	2.713	3.139	1.141	0.869	0.900	1.026	1.190	1.169
6	N_2K_2	0.454	0.285	0.359	0.365	0.359	0.389	2.640	2.575	3.147	3.001	3.012	3.374	1.047	0.812	0.875	1.046	1.088	1.151
7	$N_1P_1K_1$	0.445	0.282	0.411	0.449	0.375	0.461	2.634	2.508	3.138	3.119	2.818	3.230	1.075	0.821	0.836	1.005	1.006	1.165
8	$N_2P_2K_2$	0.415	0.273	0.446	0.496	0.461	0.475	2.597	2.596	3.113	3.019	2.920	3.313	1.039	0.702	0.880	1.001	1.026	1.187
9	Control	0.389	0.360	0.409	0.385	0.364	0.375	2.666	2.609	3.274	2.717	2.933	3.483	0.992	0.709	0.835	1.031	0.958	1.135
10	Plain water	0.450	0.292	0.415	0.366	0.351	0.332	2.425	2.467	3.012	2.865	2.472	2.766	1.086	0.847	0.900	1.037	1.025	1.223

*I Set collected at 7 a.m. before application of treatments; *II Set collected 2 hours after the application of treatments; *III Set collected 4 hours after application of the treatments; *IV Set collected 8 hours after application of the treatments; *V Set collected 24 hours after application of the treatments; *VI Set collected 48 hours after application of the treatments.

(1) N_1: 20 lb. Nitrogen/acre sprayed as Urea solution; (2) N_2: 40 lb. Nitrogen/acre sprayed as Urea solution; (3) N_1P_1: 20 lb. Nitrogen as in (1) +15 lb. P_2O_5/acre as Ammonium Phosphate; (4) N_2P_2: 40 lb. Nitrogen +30 lb. P_2O_5 sprayed as in (3); (5) N_1K_1: 20 lb. Nitrogen as in (1) +20 lb. K_2O as Muriate of Potash; (6) N_2K_2: 40 lb. Nitrogen +40 lb. K_2O as in (5); (7) $N_1P_1K_1$: 20 lb. Nitrogen +15 lb. P_2O_5+20 lb. K_2O; (8) $N_2P_2K_2$: 40 lb. Nitrogen +30 lb. P_2O_5 +40 lb. K_2O; (9) Control: No treatment; (10) Sprayed with the same quantity of plain water used for the above solutions.

APPENDIX 'C'— XV

Studies on the Diurnal Variations of Plant Nutrients in Coffee

(Average of three plants)

Sl. No.	PARTICULARS	Temperature in degrees Centigrade	Relative humidity %	Light intensity in foot-candles	Analytical data of leaf samples—Values on moisture free basis					
					Organic Carbon %	Total Nitrogen %	C/N Ratio	Total P_2O_5%	Total Potassium %	Total Calcium %
1	I Set collected at 6-00 a.m.	19.0	97.0	1.5	43.41	2.416	17.97	0.3476	2.410	0.9500
2	II „ „ 7-00 a.m.	19.0	97.0	47.0	43.36	2.549	17.01	0.3643	2.416	0.9826
3	III „ „ 8-00 a.m.	18.4	97.0	420.0	44.03	2.477	17.78	0.3286	2.246	1.0900
4	IV „ „ 9-00 a.m.	19.5	95.0	880.0	44.89	2.659	16.89	0.3163	2.307	1.0130
5	V „ „ 10-00 a.m.	22.8	90.0	5,233.0	44.89	2.388	18.79	0.3176	2.321	1.0386
6	VI „ „ 11-00 a.m.	28.5	69.8	3,167.0	45.43	2.513	18.08	0.3803	2.357	0.9833
7	VII „ „ 12-00 noon	33.5	71.0	2,267.0	46.23	2.537	18.23	0.3740	2.403	0.9685
8	VIII „ „ 1-00 p.m.	31.5	52.0	3,670.0	45.79	2.423	18.90	0.3323	2.383	1.0803
9	IX „ „ 2-00 p.m.	33.0	50.0	2,530.0	44.93	2.438	18.43	0.3643	2.253	1.0536
10	X „ „ 3-00 p.m.	35.2	46.0	3,630.0	45.35	2.522	17.99	0.3893	2.376	1.0210
11	XI „ „ 4-00 p.m.	30.5	50.0	1,490.0	44.88	2.557	17.56	0.3663	2.378	0.9816
12	XII „ „ 5-00 p.m.	28.5	58.0	303.0	45.45	2.491	18.25	0.3643	2.270	0.9390
13	XIII „ „ 6-00 p.m.	26.4	67.0	130.0	44.67	2.458	18.18	0.3370	2.390	0.9876
14	XIV „ „ 7-00 p.m.	23.6	79.0	1.0	44.95	2.400	18.73	0.3283	2.245	0.9343

APPENDIX 'C'—XVI

Seasonal Variations of Plant Nutrients in Coffee Leaf

Analytical data of leaf samples collected from N.M.S. I

(Values on moisture free basis)

Particulars	March 1960	April 1960	May 1960		June 1960		July 1960		August 1960		Sept. 1960		Oct. 1960		Nov. 1960		Dec. 1960	Jan. 1961	Feb. 1961
			*B	**NB	B	NB	B	NB	B	NB	B	NB	B	NB	B	NB			
Total Nitrogen:																			
Control	3.140	3.374	3.664	3.907	4.020	3.936	3.612	3.551	3.157	3.111	3.353	3.709	3.611	4.634	3.899	4.446	3.960	3.516	3.761
Nitrogen	3.630	3.679	3.983	3.672	4.080	4.232	3.714	3.331	3.892	3.223	3.552	3.441	3.585	4.042	4.392	4.331	4.004	3.870	4.041
N + P	3.320	3.368	3.848	2.796	3.836	3.664	3.592	3.628	3.280	3.147	3.245	3.827	4.498	4.315	4.084	4.213	3.823	3.667	3.546
N + K	3.400	3.901	2.814	2.533	3.790	3.820	3.790	3.496	3.217	3.209	3.506	3.468	3.958	3.819	4.226	4.323	3.799	3.625	3.582
N + P + K	3.320	3.904	2.635	2.808	3.791	3.966	3.528	3.374	3.045	2.955	3.537	3.395	3.453	3.816	3.970	4.095	3.997	3.771	3.866
Organic Carbon:																			
Control	36.87	40.99	43.37	41.95	49.89	49.46	47.49	48.07	47.24	46.00	48.19	48.19	47.08	46.30	52.77	53.60	41.80	42.38	47.55
Nitrogen	36.53	40.79	44.51	44.12	49.75	48.18	47.66	46.48	46.82	47.07	49.09	47.34	47.54	46.28	54.65	48.03	40.29	41.39	47.62
N + P	38.01	41.49	46.07	45.14	49.45	48.25	47.97	48.87	46.46	46.03	48.44	46.84	46.73	46.62	50.90	51.37	40.40	40.01	47.24
N + K	36.36	41.34	45.48	45.25	49.13	48.20	48.14	47.25	47.43	45.53	49.15	48.33	47.42	46.84	50.82	50.97	39.31	39.51	47.25
N + P + K	38.09	39.48	44.83	43.39	48.07	47.83	48.07	47.41	46.38	43.81	48.02	47.57	46.27	46.30	51.31	49.86	39.67	39.41	47.26

* B = Bearing branch.

** NB = Non-bearing branch.

APPENDIX 'C' — XVI (Contd.)

Particulars	March 1960	April 1960	May 1960		June 1960		July 1960		August 1960		Sept. 1960		Oct. 1960		Nov. 1960		Dec. 1960	Jan. 1961	Feb. 1961
			B	NB	B	NB	B	NB	B	NB	B	NB	B	NB	B	NB			
Carbon by Nitrogen Ratio:																			
Control	11.74	12.15	15.90	16.39	20.05	19.46	13.15	13.52	14.96	14.79	14.37	12.99	13.04	9.91	13.54	12.06	10.55	12.05	12.59
Nitrogen	10.06	11.09	17.73	16.20	20.30	20.38	12.83	13.95	12.03	14.60	13.82	13.76	13.26	11.45	12.45	11.09	10.07	10.69	11.79
N + P	11.45	12.32	17.76	12.62	18.97	17.68	13.36	13.47	14.17	14.63	14.93	12.24	10.39	10.80	12.47	12.19	10.57	10.91	13.32
N + K	10.69	10.59	12.80	11.47	18.62	18.41	12.71	13.52	14.74	14.19	14.02	13.93	11.98	12.27	12.03	11.79	10.35	10.90	13.19
N + P + K	11.47	10.11	11.81	12.18	18.22	18.97	13.62	14.05	15.23	14.83	13.57	14.02	13.40	12.13	12.92	12.17	9.92	10.45	12.22
Total Phosphoric Acid:																			
Control	0.414	0.360	0.327	0.372	0.300	0.317	0.279	0.299	0.321	0.304	0.311	0.330	0.395	0.406	0.438	0.479	0.423	0.367	0.359
Nitrogen	0.430	0.359	0.326	0.386	0.303	0.323	0.280	0.275	0.348	0.332	0.320	0.331	0.367	0.367	0.422	0.470	0.399	0.390	0.347
N + P	0.477	0.383	0.411	0.383	0.370	0.352	0.381	0.369	0.418	0.404	0.412	0.417	0.489	0.435	0.504	0.494	0.424	0.389	0.367
N + K	0.405	0.416	0.288	0.360	0.296	0.282	0.317	0.294	0.358	0.342	0.369	0.346	0.390	0.348	0.469	0.487	0.371	0.379	0.331
N + P + K	0.308	0.477	0.433	0.395	0.381	0.353	0.382	0.339	0.377	0.494	0.417	0.524	0.421	0.407	0.550	0.543	0.490	0.341	0.356

APPENDIX 'C'—XVI (Contd.)

Particulars	March 1960	April 1960	May 1960		June 1960		July 1960		August 1960		Sept. 1960		Oct. 1960		Nov. 1960		Dec. 1960	Jan. 1961	Feb. 1961
			B	NB	B	NB	B	NB	B	NB	B	NB	B	NB	B	NB			
Total Potassium:																			
Control	2.324	3.340	3.291	3.216	2.818	2.678	2.229	2.169	1.776	1.839	1.512	1.673	2.450	2.671	3.200	3.416	3.414	3.249	2.913
Nitrogen	2.258	3.430	3.210	3.123	2.805	2.939	2.191	2.131	1.729	1.665	1.546	1.640	2.555	2.624	3.206	3.116	3.563	3.278	3.241
N + P	2.432	3.330	3.029	3.132	2.756	2.851	2.094	2.177	1.801	1.727	1.559	1.707	2.685	2.786	3.029	3.243	3.487	3.363	3.080
N + K	2.507	3.420	2.986	3.176	2.930	2.841	2.270	2.230	1.832	1.797	1.592	1.672	2.679	2.660	3.134	3.443	3.387	3.486	3.240
N + P + K	2.440	3.300	3.080	3.201	2.791	2.932	2.128	2.279	1.659	1.799	1.480	1.699	2.624	2.695	3.263	3.409	3.279	3.284	3.336
Total Calcium:																			
Control	1.044	1.037	1.243	1.109	0.908	1.040	1.104	0.894	0.739	0.614	0.724	0.600	0.886	0.754	1.043	1.003	0.991	0.964	1.106
Nitrogen	1.059	1.069	1.176	1.113	1.142	1.028	1.004	0.806	0.730	0.583	0.676	0.667	0.831	0.694	1.043	0.897	1.012	0.906	1.051
N + P	1.078	0.974	1.146	1.177	1.198	1.049	1.121	0.971	0.690	0.551	0.759	0.635	0.859	0.770	1.029	0.931	1.051	0.954	1.166
N + K	1.102	0.994	1.146	1.077	1.088	1.038	1.070	0.905	0.626	0.524	0.731	0.588	0.843	0.659	1.102	0.976	1.040	0.890	1.053
N + P + K	1.026	1.014	1.192	1.157	1.025	1.071	1.123	0.928	0.673	0.521	0.738	0.580	0.806	0.654	1.275	1.138	1.036	0.889	1.166

APPENDIX 'C' — XVII

Analytical Data of Leaf Samples Collected from Station Selections

(Values on moisture free basis)

Sl. No.	PARTICULARS	Total Nitrogen %	Organic Carbon %	Carbon Nitrogen ratio	Total P_2O_5 %	Total Potassium %	Total Calcium %	Total Ash %
1	S-288 Planted 1932	2.252	47.93	21.28	0.3465	2.725	0.9264	9.374
2	S-333 Planted 1934	2.382	47.72	20.03	0.4276	2.194	0.8058	8.093
3	S-795 Planted 1942	2.398	47.78	19.93	0.3962	2.905	0.9036	9.738
4	S-795 Planted 1952 (Hedgerow)	2.256	48.16	21.34	0.3735	2.229	0.9826	9.299
5	Coorg's	3.760	43.28	11.52	0.4090	3.586	0.557	—
6	Kent's	3.510	46.09	13.15	0.3420	2.519	0.763	—

APPENDIX 'C' — XVIII

Analytical Data of Leaf Samples Collected from World Collections

(Values on moisture free basis)

Sl. No.	PARTICULARS	Total Nitrogen %	Organic Carbon %	Carbon/ Nitrogen	Total Phosphoric acid %	Total Potassium %	Total Calcium %
1	Bourbon vermellho	2.443	40.25	16.47	0.309	3.375	0.918
2	Bourbon amarello	2.765	39.96	14.45	0.410	3.833	1.015
3	Caturra amarello	2.641	42.07	15.92	0.426	3.701	1.054
4	Laurina margogype	2.457	39.56	16.10	0.381	3.670	0.914
5	Mundonovo	2.580	41.04	15.91	0.434	3.405	1.008
6	Typica	2.494	41.06	16.46	0.448	3.468	0.928
7	Bourbon	2.412	41.15	17.03	0.347	3.201	1.026
8	Pache	2.487	39.68	15.95	0.341	3.017	0.349
9	Leroy	2.707	40.33	14.89	0.342	2.998	0.832
10	Sumatra	2.728	42.96	15.75	0.375	3.963	0.884
11	Surinam	2.367	40.45	17.09	0.331	3.291	0.907
12	Blue-Mountain	2.816	40.37	14.34	0.342	3.290	0.895
13	Sanramon	2.199	41.47	14.76	0.401	3.135	0.881
14	Padang	2.821	41.65	14.24	0.401	3.220	0.924
15	Guada loupe	2.869	40.87	14.24	0.348	3.078	0.885
16	Columnaris	2.787	40.46	14.52	0.349	3.710	0.871
17	Pretoria	2.835	40.19	14.18	0.432	3.207	0.894
18	S. 795	2.880	44.60	15.51	0.507	2.143	0.411
19	Coorg's	3.760	43.28	11.52	0.409	3.586	0.557
20	Kent's	3.510	46.09	13.15	0.342	2.519	0.763
21	Kona	3.137	46.82	14.93	0.400	3.193	0.908
22	Thillippinian	3.049	48.73	15.98	0.375	3.250	0.887
23	N. 39	2.861	45.40	15.87	0.416	3.009	0.827
24	KP 423	2.767	43.41	15.69	0.362	2.676	0.847
25	KP 162	2.765	43.01	15.56	0.334	2.555	0.893
26	N. 205	2.987	41.60	15.05	0.308	2.849	0.921
27	H. 66	2.910	41.07	14.11	0.371	2.599	0.843
28	KP 532	2.804	43.63	15.56	0.387	2.680	0.879
29	Mibirizi	3.099	41.69	13.45	0.338	3.066	1.084
30	Arabagougou	2.906	40.28	13.86	0.323	3.387	0.980
31	N. 197	2.856	49.13	17.20	0.357	3.097	0.984
32	S. 8-Taffarikela	3.125	51.63	16.52	0.329	2.424	0.936
33	S. 12-Kaffa	3.027	49.69	16.41	0.277	2.478	0.876
34	Kawisari-B	2.493	47.74	19.15	0.289	2.579	0.985
35	S. 16-Wallamo	2.987	48.87	16.36	0.279	2.444	0.889
36	S. 2B-Ennerio	2.864	52.02	18.16	0.255	2.631	0.966
37	S. 17-Yrgalem	2.757	49.27	17.87	0.376	2.453	0.848

IV. ENTOMOLOGY

1. The Division of Entomology undertook the following fields of study during the year under report:—

A. Survey on the seasonal intensity of incidence of pests of coffee—Insects and nematodes.

B. Applied Research—Observations on the chemical control experiments at the Coffee Research Stations and at various Liaison Zones.

C. Basic Research—

(i) Laboratory and field studies on the habits, life history and ecological relationships of pests of coffee.

(ii) Recording the comparative abundance and activity of predator and parasite species of coffee pests and studies thereon.

(iii) Collection, identification and preservation of insects.

(iv) Studies on nematodes—distribution of species and relative pathogenecity.

A. SURVEY ON THE SEASONAL INTENSITY OF INCIDENCE OF PESTS OF COFFEE

2. Survey operations consisted in assessing the levels of incidence of the following pest species:—

(1) Nematodes.

(2) Shot hole borer—*Xyleborus morstatti* Hgdn.

(3) Green bug—*Coccus viridis* Gr.

(4) Red borer—*Zeuzera coffeae* Nietn.

(5) White stem borer—*Xylotrechus quadripes* Chev.

(6) Hairy caterpillar—*Eupterote* spp.

(7) Aphids, Mealy bugs, Leaf hoppers and Thrips.

2.1. As in the past few years, nematodes maintained a major pest status. Given below are the names of estates from where suspected materials were collected and examined for parasite species:

(a) Koppa—

(1) Karadikhan
(2) Gungegiri
(3) Shegode
(4) Murgadhae
(5) Maduba

(b) Chikmagalur—

(1) Chandragiri

(c) Mudigere—
  (1) Balur
  (2) Urvinkhan

(d) North Coorg—
  (1) Tanneerhalla
  (2) Jamboor
  (3) Wooligooly

(e) South Coorg—
  (1) Pollibetta
  (2) Chowdicadoo
  (3) Elk Hill
  (4) Honey Farm

(f) Nilgiris—
  (1) Lauriston

(g) Wynaad—
  (1) Cottanad

(h) Pulneys—
  (1) Sekharan

(i) Coffee Research Station, Balehonnur.

Note:—The species of nematodes detected and their relative pathogenecity are dealt with in Section, Basic Research, Sub-Section(iv).

2.2. The incidence of shot hole borer attained markedly high proportions at Wynaad, South Coorg, Saklespur, Koppa, Anamalais and Nilgiris during the latter half of 1960. At the Coffee Research Station, Balehonnur, the incidence level reached a peak in October 1960. Reduction in the level was apparent from January 1961. In general, the intensity was more in 1960-61 than in 1959-60 (Table I).

2.2.1. A comparison of the data in Table I for the seasons, 1957-58, 1958-59, 1959-60 and 1960-61 would show that prevalence of high and continuous rainfall in a year retarded the intensity of incidence in the following season while low and intermittent rainfall with comparatively high temperatures (19°C.—24°C. approximately) accelerated the intensity. Also, the initial build-up of the pest population was apparently determined by the amount of rainfall obtained during the commencement of the South-West monsoon; higher the rainfall in June-July lower the degree of incidence and vice versa. In the latter event, the amount of rainfall in Oct.-Nov. seemed to control the sustenance of the pest population; this reaching a higher level (peak) in a season that correspondingly had heavier precipitation in Oct.-Nov. than in others.

2.3. Green bug incidence was high in Nilgiris during Sept.-Decr. Heavy but sporadic outbreaks occurred in Shevroys, Pulneys, North Coorg, Saklespur, Chikmagalur and Koppa Zones in early 1961.

2.4. The incidence of red borer was negligible in most zones. Stray infestations were reported at North Coorg. At the Coffee Research Station, Balehonnur, as in the previous year, incidence in the five selected blocks remained higher than that in the rest of the estate; three plants and one plant per acre respectively. Of the selected blocks, NMS V exhibited higher incidence intensity (six plants per acre) than any of the remaining four blocks. Peak incidence was reached in April 1961. The incidence in the whole of the estate was only one plant as opposed to three per acre in 1959-60 (Table II).

2.5. Severe incidence of white stem borer was reported in Chikmagalur and at lower elevations of Kilkotagiri and Nilgiris. At the Coffee Research Station, Balehonnur, the incidence was as low as one plant per acre, thus evidencing a reduction by 80 per cent from the 1959-60 season.

2.6. Incidence of hairy caterpillars was observed in a few estates at Nilgiris and in young clearings in Wynaad and South Coorg during the latter half of 1960. The species did not cause much concern at Chikmagalur.

2.7. Aphids, leaf hoppers, mealy bugs and thrips were prevalent from September in many coffee zones. Incidence of the latter was reported noticeably high in several estates in North Wynaad, Saklespur, North Coorg and Nilgiris.

B. APPLIED RESEARCH

3. *Laboratory and Field Experiments on the Chemical Control of Pests of Coffee:*

3.1. WHITE STEM BORER — *Xylotrechus quadripes* Chev.
(Coleoptera, Cerambycidae)

3.1.1. Two field experiments were in progress.

EXPERIMENT 1: Trials with W.L. 1650 15 E.C. and *B.H.C. 50 W.P.*

Locality: Chandrakhan Estate, Koppa Zone.

Started: June 1961.

Details: Treatments — 5 (non-replicated)

A) W.L. 1650	0.2 a.c.	(396	plants)
B) —do—	0.5 a.c.	(494	,,)
C) B.H.C.	0.2 a.c.	(491	,,)
D) —do—	0.5 a.c.	(437	,,)
E) Control		(467	,,)

Swabbing Sequence:

(a) One swab (March — April)

(b) Two swabs (,, and Sept. — Oct.)

(c) Three swabs (,, ,, and Nov.)

Plant material: S. 795.

Methods:

(i) Exhaustive initial borer tracing and removal.

(ii) Imposition of treatments on all the plants—(Sub-treatment I)—A, B etc.

(iii) Tracing and removal (a) September and (b) October—record infestations treatmentwise—A, B etc.

(iv) Imposition of treatments on all plants (Sub-treatment II)—the timing of swab to be arrived at on the basis of probable peak emergence.

(v) Imposition of treatments on half the number of plants (Sub-treatment III) —A2, B2 etc. in each treatment in November-December.

(vi) Tracing and removal—March, April—record infestations plotwise—A1, A2, B1, B2 etc.

(vii) Repeat tracing and swabbings as above.

Data obtained aim to determine the effect of (1) *one swab* (March-April) on all plants as evidenced by infestation recorded during September-October tracing of the corresponding year; (2) *two swabs* (March-April, and September-October) on half the number of existing plants, A, B, etc., plotwise, as evidenced by infestation recorded during the succeeding March-April tracings before the imposition of April swab; and (3) *three swabs* (March-April, September-October, and November) on the remaining number of plants, A2, B2 etc., plotwise, as evidenced by infestation recorded during the succeeding March-April tracings before the imposition of April swab.

EXPERIMENT 2 : Trials with B.H.C. 50 W.P., Gusathion 20 E.C., and Heptachlor 25 W.P.

Locality : Chennanahalli Estate, Chikmagalur Zone.

Started : May 1959.

Details : Treatments—5 (non-replicated)

A) Control.
B) B.H.C. 1.0 a.c. twice/year.
C) B.H.C. 1.0 a.c. thrice/year.
D) Gusathion 0.1 a.c. twice/year.
E) Heptachlor 0.1 a.c. thrice/year.

Plot size : 20×25 (500) plants—Gross.
18×23 (414) ,, —Nett.

Plant material : Kents.

Experiment 2 is expected to continue till the end of 1961.

EXPERIMENT 3: Studies on the Effect of B.H.C. Swab on Cup Quality and Borer Incidence.

Locality: Coffee Research Station, Balehonnur.

This experiment reported earlier (Ann. Rep. 1959-60) was in progress. Results (Table III) obtained through quality tests, so far, indicated that samples from bushes that were unswabbed in both the seasons (R-Block) and from those unswabbed in October (L1-Block) were not bricky in flavour. Samples representing both the seasonal

swabs (1960—Q and 1961—Old Block) were bricky and this flavour was apparently absent in further samples obtained from Q-Block in 1961. As programmed Q-Block did not receive the swab in April 1960—the year preceding collection of material for the 1961 tests. From the above it appeared that two swabs promote possibilities of taint.

Considering the degree of borer incidence, the following observations were apparent (Table IV). R-Block which received no swab in either seasons did not manifest higher levels of borer incidence per acre in the periods April 1959—March 1960 and April 1960—March 1961 than in April 1958—March 1959. L1-Block, where the October swab was discontinued since 1959, exhibited considerable increase in infestation in the April 1960—March 1961 period. In comparison with the above two blocks, the Old Block receiving two swabs maintained incidence level higher than R-Block but lower than L1-Block in similar periods. Q-Block, where the April swab was discontinued since 1960, appeared to have less incidence in April 1960—March 1961 than in April 1959—March 1960 period while in the Old Block receiving two swabs, the corresponding levels of incidence were still less. Further data, however, have to be obtained before arriving at definite conclusions.

3.2. GREEN BUG—*Coccus viridis* Gr.
(Hem. Homoptera, Coccidae)

EXPERIMENT 1: Trials with Systemic and Non-Systemic Insecticides.

Locality: Madbur Estate, Koppa Zone.

Started: June 1960.

Details: Treatments—9.
Replications—6.
(Leaves)
Layout—Randomized.

Materials and Methods:

The insecticides listed below were tested at 0.02% and 0.04% a.c. in separate series:

(A) Basudin 20 E.C.
(B) Malathion 53 E.C.
(C) Paramar 50 E.C.
(D) Fosferno 50 E.C.
(G) Meta-iso-Systox 25 E.C.
(H) Ekatin 20 E.C.
(I) Ekatox 50 E.C.
(J) Rogor 40 E.C.
(K) Control.

There were two plants per treatment. On each plant, three pairs of leaves carrying heavy infestations of green bug were selected at random and in each pair, one leaf was used for critical population counts (nymphs and adults) on the petiole, upper and lower surfaces during initial and post-treatment observations. Thus, six leaves were counted per treatment in an observation. Post-treatment observations were conducted at the periods 10, 20 and 30 days.

Analysis of Results:

Results are interpreted separately for nymphs and adults.

Low Concentration (Table V)—*Nymphs:*—At 10 days after treatment, Paramar, Fosferno and Ekatox were significantly superior to the remaining chemicals. Malathion, Basudin, Meta-iso-Systox and Ekatin came in the next group with no significant difference among them. At 20 days, the former three with Malathion, Meta-iso-Systox and Ekatin showed comparable potencies. At 30 days all the chemicals appeared similar in effectiveness.

Adults:—At 10 days, Paramar, Fosferno, Ekatox and Malathion proved more effective than the rest while there was no significant difference between the effectiveness of Malathion, Basudin and Ekatin. At 20 days, all the aforesaid chemicals were found equally effective and there was no significant difference in effectiveness between the latter three and Meta-iso-Systox. At 30 days, almost the same trend in effectiveness was maintained by all the chemicals except Basudin and Rogor which appeared less effective.

Considering the effectiveness on the total population, all the chemicals, except Rogor, were equally effective at 10 days. In this respect, a comparison of the results from earlier experiments (Ann. Rep. 1959-60) would show consistency in the case of Paramar, Fosferno, Malathion and Ekatin. At 20 and 30 days, there was no appreciable change in the pattern of effectiveness.

High Concentration (Table VI)—*Nymphs:*—As in the case of low concentration, Paramar, Fosferno and Ekatox maintained their superiority in effectiveness over other chemicals at 10 days. Also, Ekatin, Malathion and Rogor appeared as potent as the former. There was no significant difference between the effectiveness of Ekatin, Meta-iso-Systox and Basudin. At 20 days, all the chemicals except Rogor showed similar degree of effectiveness and at 30 days, the systemics, Rogor and Meta-iso-Systox, appeared less effective than the rest.

Adults:—Paramar, Fosferno and Ekatox showed consistently superior effectiveness throughout the periods of observation. In general, Malathion, Basudin and Ekatin appeared to possess better degree of effectiveness among the remaining chemicals in the three observational periods.

The degree of effectiveness on the total population followed almost similar trends in that Paramar, Fosferno and Ekatox maintained their superiority over the rest throughout. Malathion, Ekatin and Basudin were found comparably effective at 20 and 30 days. Meta-iso-Systox and Rogor appeared less effective than the aforesaid chemicals.

Extended analysis (Tables VII and VIII) of the results for the two concentrations of chemicals in the first group at similar periods for nymphs and adults indicated the following:—

(i) Low and high concentrations of Paramar, Fosferno and Ekatox and high concentration of Ekatin were significantly similar in effectiveness on nymphs at the 10th day period and there was no significant difference between the effectiveness of the high concentration of the latter, Malathion and Rogor. In the same period, on adults, both the concentrations of Fosferno, Paramar and Ekatox were equally effective.

(ii) At 20 days, the comparison did not prove significant in the case of nymphs while for adults, low and high concentrations of Ekatox and Paramar and low concentration of Fosferno possessed significantly similar degree of effectiveness.

(iii) At 30 days, low and high concentrations of Paramar, Fosferno, Ekatox, Malathion and Basudin and low concentration of Rogor, Ekatin and Meta-iso-Systox were equally effective on nymphs. In the same period, low and high concentrations of the former three and high concentration of Basudin and low concentration of Malathion and Meta-iso-Systox exhibited similar degree of effect on adults. Also, there was no significant difference between the effectiveness of the low concentration of Ekatox, Meta-iso-Systox and Malathion on the one hand and high concentration of Fosferno, Basudin and Malathion on the other.

EXPERIMENT 2 : Trials with Fosferno 50 E.C., Gusathion 25 W.P. and Paramar 50 E.C.

Locality : Gavikhan Estate, Chikmagalur Zone.

Started : June 1961.

Details : Treatments—10.

D) Paramar 0.01 a.c.
E) ,, 0.02 ,,
F) ,, 0.04 ,,
G) Fosferno 0.01 a.c.
H) ,, 0.02 ,,
I) ,, 0.04 ,,
J) Gusathion 0.01 a.c.
K) ,, 0.02 ,,
L) ,, 0.04 ,,
M) Control.

Replications—3.
(Leaves)

Layout—Randomized.

Plot size—One plant.

Methods:

These were similar to Experiment 1. Observational periods were, initial, 10, 15, 25 and 35 days after treatment. Data obtained on the population of the bug (adults and nymphs) at each of the above observational periods were corrected to control figures using the formula,

$$\frac{Pt \pm P_cK}{100 \pm P_cK} \times 100$$

to ascertain the per cent effectiveness of each treatment (Pt=counted mortality in treated population from initial, expressed in per cent. PcK=change in population in check; +increase; —decrease). The values thus obtained for various treatments/periods were then statistically analysed.

Analysis of Results:

The data (Table IX) showed that at 10 days after treatment the results were not significant. At 15 days, all three concentrations of Paramar and Gusathion and the low concentration of Fosferno (0.01) were on a par while at 25 days, Paramar (0.04) and Fosferno (0.02 and 0.04) exhibited markedly superior effectiveness and there was no significant difference between this and the effectiveness of most of the other treatments. Also, Fosferno, Paramar (0.01) and Gusathion (0.01 and 0.04) appeared significantly similar in effectiveness. At 35 days, Paramar (0.04) and Fosferno (all concs.) proved highly effective though the effectiveness of Paramar (0.01 and 0.02) and Gusathion (0.01) was not significantly different from the former.

It is to be noted, however, that the above interpretations are based on data collected at various periods wherein rainfall occurred in the following intensities:

Between spray and 10th day (initial rainfall two days after spray)—5.45 inches.

Between 10th day and 15th day—1.75 inches.

Between 15th day and 25th day—0.90 inches.

Between 25th day and 30th day—20 inches approx.

This has obviously interfered with the population counts at each period; especially with regard to active nymphs; bringing about discrepancies in the data collected. A high degree of wash off of the insecticides in general and the wettable powder in particular on account of rain has also occurred and this apparently varied among plants in the experiment depending upon their situation in the field. Subsequent reinfestation could have taken place but in the aforesaid conditions it would be disadvantageous to weigh the merits and/or demerits of the treatments in equal terms.

Further experiments with the above chemicals are, hence, thought necessary to arrive at definite conclusions.

3.3. SHOT HOLE BORER—*Xyleborus morstatti* Hgdn.
(Coleoptera, Scolytidae)

EXPERIMENT 1: *Trials with Rogor 40 E.C., Meta-iso-Systox 25 E.C. and Ekatin 0 E.C.*

Locality: Coffee Research Station, Balehonnur.

Started: May 1960.

Details: (Ann. Rep. 1959–60)

Spray trials with the above systemics were in progress till December 1960. The chemicals were tested at 0.02% and 0.04% a.c. each and applications were imposed at monthly and bi-monthly intervals for both the concentrations. Observations involved monthly recording of infestation on 50 tertiary branches of similar age, selected at random, per plant. Data obtained for the period of experimentation did not evidence any appreciable degree of pest control in any category of treatments. As such, further analysis of results was not attempted. Thus, it appeared that the systemics were not effective to control the pest species in the field as opposed to that observed in earlier preliminary trials.

The experiments are concluded.

EXPERIMENT 2: *Trials with Dieldrin 18 E.C., Gusathion 20 E.C. (with and without 2.2.40—½%—Bordeaux Mixture), and W.L. 1650 15 E.C.*

Locality: Madbur Estate, Koppa Zone.

Started: September 1960.

Details:

Series I
(without Bordeaux mixture)
Treatments:—7

A) Dieldrin 0.2 a.c.
B) ,, 0.4 a.c.
C) Gusathion 0.05 a.c.
D) ,, 0.1 ,,
E) Control.
F) W.L. 1650 0.05 a.c.
G) ,, 0.1 ,,

Replications: 6.
(1 plant/Rep.)

Series II
(with Bordeaux mixture)
Treatments:—5

A) Dieldrin 0.2 a.c.
B) ,, 0.4 a.c.
C) Gusathion 0.05 a.c.
D) ,, 0.1 ,,
E) Control.

Replications: 6.
(1 plant/Rep.)

Layout: Randomized.

Spray sequence: First spray (Sept. 1960)
Second „ (Oct. 1960)
Third „ (Nov. 1960)

(Further sprays not imposed due to the approach of harvest)

Observations: Initial (Sept. 1960 — before spray)
Second (Oct. 1960 — „)
Third (Nov. 1960 — „)
Fourth (Dec. 1960)
Fifth (Jan. 1961)

Methods:

At each of the above observations, 50 tertiary branches of similar age were selected at random per plant for exhaustive counts on the total number of infestations, and the stages in tunnels.

The effect of a particular treatment was assessed not only in terms of the degree of damage—tunnels—produced by the beetles, but also in terms of the number of stages developing within such tunnels; the latter serving as the nucleus of further infestations. The results obtained in the above two aspects are dealt with below for each series.

Analysis of Results:

Infestations with Tunnels: Attempts were made to take into consideration, as far as possible, only fresh infestations (tunnels) by excluding the data of September and October in deriving conclusions. Thus, the conclusions were based on data for the month of November (after two sprays), December (after three sprays) and January (after three sprays). Values obtained on the effectiveness of the respective chemicals in the aforesaid periods were compared with those of the corresponding controls.

The results (Table X) for Series I (without Bordeaux mixture) did not denote significance throughout. Series II (with Bordeaux mixture), on the other hand, gave significant results where in November, December and January, both the concentrations of chemicals were superior to control.

Stages: Considering that an adult female oviposited for durations ranging from two to three weeks in tunnels and that the average duration of the life cycle was about four weeks, the effect of insecticides in controlling the population and resultant infestation could properly be evaluated only after a few sprays. Based on the above observations, the second set of population counts before the corresponding sprays (October) at a month's interval from the first set (September) was taken to represent the initial level of infestation and with this comparisons for subsequent stipulated periods were drawn. This procedure—*i.e.*, elimination of September data in comparisons—was thought to exclude, to some extent, an initial population, consisting of individuals not exposed to the effect of sprays in September, from being counted in October as representing cases

of fresh incidence and thus masking the results. Hence, the comparisons attempted and discussed below broadly pertain to,

(i) November (effect after two sprays);
(ii) December (effect after three sprays);
(iii) January (effect after three sprays; two months after the third spray in November).

The results (Table XI) indicated that Series I (without Bordeaux mixture) did not significantly effect reduction in the pest population from initial in any of the aforesaid periods. Series II (with Bordeaux mixture), however, evidenced significant reduction in pest population in November, from initial, where both the concentrations of Dieldrin were superior to control. Gusathion appeared less effective. In contrast, December and January did not show further significant reductions from the initial level. This was probably due to the higher rate of increase in pest population coinciding with the peak incidence period as discussed before. In the latter two months, the corrected effectiveness of the chemicals, in comparison with the respective control data, however, showed statistical significance. Thus, in December, Dieldrin (0.4 a.c.) was superior to Gusathion and there was no significant difference between the two concentrations of the former and between the low concentration of Dieldrin and Gusathion. In January—two months after the third spray—Dieldrin, in general, appeared more effective than Gusathion although the data did not evidence a consistent pattern.

Further field tests are necessary to draw final conclusions. To this end, a spray trial with the above chemicals is in progress.

3.4. ROOT MEALY BUG—*Pseudococcus citri* Riss. (Hem. Homoptera, Coccidae)

EXPERIMENT 1: Trials with Fosferno, Paramar, Basudin, Dieldrex, Ekatox, Malathion, Gusathion and W.L. 1650.

Locality: Appee's Estate, South Coorg.

Started: February 1961.

Details:

Treatments: 9—

A) Fosferno 50 E.C.
B) Paramar 50 E.C.
C) Basudin 20 E.C.
D) Dieldrex 18 E.C.
E) Ekatox 50 E.C.
F) Malathion 53 E.C.
G) Gusathion 20 E.C.
H) W.L. 1650 15 E.C.
I) Control.

Each chemical tested at 0.02% and 0.04% a.c. in two series.

Replications: 3.

Plot size: 4 plants (Series I);
3 plants (Series II).

Layout: Randomized.

Methods:

Methods described earlier (Ann. Rep. 1958-59) were followed. Following initial population recordings, observations on the intensity of bug population, 2-3″ below ground level, were conducted during the intervals, 7, 10 and 15 days after treatments. Due to the practical difficulty involved in counting the number of bugs and to avoid frequent manual interference, only arbitrary standards of population intensity *viz.*, very heavy, heavy, moderate, weak and very weak, were maintained. These standards were categorised in the ratings 5, 4, 3, 2 and 1 respectively. The per cent degree of infestation in each treatment (effect of treatment) obtained by applying the formula—

$$P = \frac{\text{Sum } (n \times v) \times 100}{5N}$$

was statistically analysed for interpretations (P=degree of infestation; n=number of plants in each category; v=ratings; N=total number of plants).

Analysis of Results (Table XII):

Low Concentration: At 7 days, W.L. 1650, Fosferno and Ekatox were significantly superior to the rest of the chemicals. There was no apparent difference in effect between the latter two and Basudin and also between Ekatox, Basudin, Dieldrex and Paramar. Malathion and Gusathion proved less effective. At 10 days, Fosferno, W.L. 1650, Basudin and Paramar proved significantly superior to Dieldrex, Ekatox and Malathion. There was no appreciable difference between the effectiveness of Basudin, Paramar, Dieldrex and Ekatox. Malathion and Gusathion remained at the same level as at 7 days. At 15 days, all the chemicals, except Gusathion, exhibited a similar degree of effectiveness, though Fosferno showed greater potency in the group in question.

High Concentration: At 7 days, Paramar, Basudin, Fosferno, Ekatox and W.L. 1650 were superior to the remaining chemicals of which Dieldrex and Gusathion came next in order. At 10 days, the former chemicals maintained their superiority and the effectiveness of Dieldrex was on a par with that of Ekatox, Basudin and W.L. 1650. Gusathion and Malathion were less effective. At 15 days, only Paramar, Basudin and Fosferno showed consistency in superior effectiveness, while W.L. 1650, Dieldrex, Ekatox and Malathion were inferior to the former. Also, there was no statistically significant difference between the effectiveness of Gusathion, Dieldrex, Ekatox and Malathion.

Extended analysis of the results for either concentrations of the chemicals in the first group, at similar periods, showed the following:—

(i) At 7 days, there was no significant difference between high and low concentrations.

(ii) At 10 days, high and low concentrations of Fosferno and W.L. 1650 and high concentration of Paramar, Ekatox and Basudin possessed similar degree of effectiveness. Also, there was no significant difference between the effectiveness of high concentration of Ekatox and low concentration of Basudin as well as between the latter, high concentration of W.L. 1650 and low concentration of Paramar.

(iii) At 15 days, the comparison did not prove significant.

It was apparent that, in general, Fosferno exhibited better consistency in effectiveness than the remaining chemicals of which Paramar, Basudin and W.L 1650 could be grouped together in the descending scale of effectiveness.

Further trials are programmed.

3.5. APHIDS — (Gen. et. sp. not determined)

Population of aphids (plant lice) observed in the year at various localities enabled the Division to conduct the following preliminary laboratory experiment:—

EXPERIMENT 1: Trials with Endrin, Malathion, W.L. 1650, Paramar and Folidol.

Locality: Coffee Research Station, Balehonnur.

Started: June 1961.

Details:

Treatments: 11—

A)	Endrin	20 E.C.	0.01 a.c.
B)	,,		0.02 a.c.
C)	Malathion	53 E.C.	0.01 a.c.
D)	,,		0.02 a.c.
E)	W.L. 1650	15 E.C.	0.01 a.c.
F)	,,		0.02 a.c.
G)	Paramar	50 E.C.	0.01 a.c.
H)	,,		0.02 a.c.
I)	Folidol	46.7 E.C.	0.01 a.c.
J)	,,		0.02 a.c.
K)	Control.		

Replication: 4 (twigs).

Methods:

Twigs bearing heavy populations of aphids were sprayed with the respective chemicals after initial counts and later kept covered in inverted funnels on glass sur-

face. The cut ends of the twigs were wrapped in moistened wads of cotton. The tails of funnels were kept open to allow fumes of the insecticides, if any, to escape. Care was also taken to prevent the escape of aphids from the enclosure. Observations on the degree of effectiveness of the treatments were recorded in terms of death produced at the intervals 12, 24 and 36 hours after treatment.

Analysis of Results (Table XIII):

It was obvious that at 12 hours after treatment all the chemicals except Endrin effected significant control on the pest population. Further analysis of data for 24 and 36 hours was not undertaken since the same numerical trend in effectiveness was apparent.

3.6. HAIRY CATERPILLAR—*Eupterote* sp.?
(Lepidoptera, Eupterotidae)

EXPERIMENT 1: Trials with Systemic and Non-Systemic Insecticides.

Locality: Coffee Research Sub-Station, Chethalli.

Started: November 1960.

Details:

Treatments: 12—

A) Basudin 20 E.C.
B) Paramar 50 E.C.
C) Gusathion 20 E.C.
D) Dieldrex 18 E.C.
E) Ekatox 50 E.C.
F) Folidol 46.7 E.C.
G) Malathion 53 E.C.
H) Meta-iso-Systox 25 E.C.
I) Ekatin 20 E.C.
J) W.L. 1650 15 E.C.
K) B.H.C. 50 W.P.
L) Control.

Each chemical tested at 0.02% and 0.04% a.c. in two series.

Replications: 3 (Six caterpillars/replication).

On the basis of earlier laboratory experiments (Ann. Rep. 1958-59) further series of tests with the above insecticides were conducted.

Methods:

Caterpillars, apparently of the same instar, were obtained from Arabica coffee in the field. Those of uniformly active constitution were subjected to the respective

spray treatments making use of an atomizer. Each lot of caterpillars received approximately 7 ml. of liquid. After treatment, the caterpillars were released into glass chimneys containing fresh coffee leaves. The tops of the chimneys were covered with cheese cloth. Observations on effectiveness, in terms of dead caterpillars, were conducted at 4, 8, 24 and 48 hours after treatment. Data obtained were statistically analysed.

Analysis of Results (Table XIV):

Low Concentration: At four hours after treatment, the results were not statistically significant. At eight hours, Basudin, Folidol, Gusathion, Ekatox, Meta-iso-Systox and Paramar were superior to the remaining chemicals. The former except Meta-iso-Systox maintained their potency at the same level at 24 hours after treatment. However, there was no significant difference between the effectiveness of Ekatox, Paramar, Basudin, Gusathion and Meta-iso-Systox as also between the latter three and Ekatin; and between Gusathion, Meta-iso-Systox, Ekatin, Dieldrex, Malathion and W.L. 1650. The latter four with B.H.C. did not evidence significant difference in effectiveness from control. At 48 hours after treatment, W.L. 1650, Folidol, Ekatox, Gusathion and Paramar were superior to the rest of which Basudin appeared more effective. There was also no appreciable difference between the effectiveness of Gusathion, Paramar, Basudin and Meta-iso-Systox and also between the latter two and Ekatin; Meta-iso-Systox and Dieldrex; and Ekatin and Malathion. Further, the effectiveness of Dieldrex, Malathion and B.H.C. did not appear superior to control.

High Concentration: At four hours after treatment, Basudin, Ekatin and Gusathion were significantly superior to the rest of the chemicals. The effectiveness of Gusathion, Paramar and Folidol appeared similar as also that of the latter two and Ekatox. There was no significant difference between the effectiveness of Folidol, Ekatox, and W.L. 1650 and between the latter two and Meta-iso-Systox. However, W.L. 1650, Meta-iso-Systox, Dieldrex, Malathion and B.H.C. did not evidence significant difference in effectiveness from control. At eight hours after treatment, Basudin, Ekatin, Paramar and Gusathion remained more effective than the rest while the effectiveness of Folidol and Ekatox appeared significantly similar to that of Paramar and Gusathion. W.L. 1650 and Meta-iso-Systox showed similar potencies not significantly different from Folidol and Ekatox on the one hand and Dieldrex and Malathion on the other. The effectiveness in the case of Dieldrex, Malathion, B.H.C. and control was similar. At 24 hours after treatment, the effectiveness of Folidol and Ekatox was on a par with that of Basudin, Ekatin, Paramar and Gusathion. Meta-iso-Systox, W.L. 1650 and Dieldrex were less potent and Malathion as well as B.H.C. the least. At 48 hours after treatment, W.L. 1650 remained as effective as the rest in the first group (24 hours). The effectiveness of Meta-iso-Systox was not significantly different from that of Paramar, Ekatox, and Gusathion. Dieldrex came next in order. Malathion and B.H.C., as in earlier observations, remained the least effective.

It may be seen from the above that low and high concentrations of Basudin, Folidol, Gusathion, Ekatox and Paramar, in general, possessed quicker knock-down action than others. Further, this effectiveness was much pronounced with the high concentration of Basudin, Gusathion and Ekatin. Among the chlorinated hydrocarbon

insecticides, W.L. 1650 showed high potency comparable to the phosphates at 48 hours after treatment.

3.7. NEMATODES:

EXPERIMENT 1: Trials with Nemagon, V.C. 13 Nemacide, Soil Amendments, Farmyard Manure and Vapam.

Locality: Wooligooly Estate, North Coorg.

Started: October 1958.

Details: *Treatments:*—6 (Ref. Ann. Rep. 1958-59, pp. 90-91).

Replications:—5.

Plot size:—144 square feet holding four plants with guard rows and trenches around.

Layout:— Randomized.

The experiment was in progress till March 1961 when it was concluded. The data obtained in the two periods, December 1958—January 1960 and March 1960—March 1961, were analysed for parasites and predators.

Analysis of Results:

December 1958—January 1960 [Tables XV(a) & XV(b)]: The *treatments* were not significant for parasites and predators. *Depths* were significant at both levels for parasites but not so for predators. In the former, the depth 12"-24" showed significantly higher population than 0-12". Though significantly not different, larger population of predators existed in the depth 0-12" than in 12"-24"; thus indicating an inverse correlation between predator and parasite populations. *Months* were significant at both the levels in the case of parasites wherein December 1958 exhibited maximum population. There was no significance in the case of predators.

It was apparent that throughout the above period the parasite population maintained higher levels than the predator in both the depths irrespective of months.

March 1960—March 1961 [Tables XVI(a) & XVI(b)]: These observations succeeded renewed application of Nemagon and farmyard manure imposed after the last observation in the previous period, *i.e.*, January 1960.

As aforesaid, the *treatments* were not significant for parasites and predators. *Depths* were also not significant for both the forms. *Months* were significant for parasites and predators. In this regard, it was seen that the month of October 1960, having maximum predator population, correspondingly had less number of parasites. Also, the low level of predator population in March 1960-May 1960 was apparently correlated with a trend towards an accelerated increase of parasites in the same period.

Considering the parasite—predator status and the performance of the plants in the treatments for the total period, December 1958—March 1961, the following indications were obtained:—

(i) The peak level in parasite population occurred around December—May.

(ii) The parasite population showed considerable waning towards the end of the period.

(iii) The difference between the levels of parasite and predator populations was more narrow in the period March 1960—March 1961 than in December 1958—January 1960. This equilibrium, in its wake, probably contributed to the better growth of the bushes observed, in general, towards the latter part of experimentation.

EXPERIMENT 2 : Pot Trials with Nematicides, Systemic and Non-Systemic Insecticides.

Locality : Coffee Research Station, Balehonnur.

Started : July 1960.

Details : *Treatments :* 6—

A) En-18133 25 W.P. 0.04 a.c.
B) Nemagon ,,
C) Meta-iso-Systox 25 E.C. 0.04 a.c.
D) Ekatin 20 E.C.
E) Malathion 53 E.C. ,,
F) Control.

Replications :—2 (One pot with four Arabica coffee plants/replication).

This exploratory experiment reported earlier (Ann. Rep. 1959-60) was in progress and was aimed at assessing the comparative effectiveness of the above chemicals on populations of nematode parasites; predominantly *Rotylenchulus* sp. Exhaustive counts of nematodes in soil were made in the periods, initial (before treatment); 15 and 45 days after treatment. Data collected for the post-treatment observational periods were corrected for effectiveness (per cent) by making use of the formula—

$$\frac{Pt \pm P_cK}{100 \pm P_cK} \times 100$$

Analysis of Results (Table XVII):

It was seen that the nematicides, in general, were superior to the insecticides in controlling the parasites. Counts conducted approximately six months after the initial showed the persistence of parasites in all the insecticidal treatments, especially in the case of Ekatin where a considerable increase was apparent. Standard of growth of the plants continued to be satisfactory in all treatments throughout the period.

Analysis of plant material (leaves) for nutrients at 45 days, indicated that total Calcium in the leaves of plants treated with Ekatin was lower than in those of the re-

maining treatments while levels of Nitrogen and Potassium were comparatively low in the case of Malathion.

The observations, however, are only preliminary and hence would warrant detailed verification.

EXPERIMENT 3: Pot Trials with Basudin, Gusathion, Fosferno and Paramar.

Locality: Coffee Research Sub-Station, Chethahalli.

Started: June 1960.

Details: *Treatments:* 9—
(Ref. Ann. Rep. 1959–60).

Replications: 3.

Due to the very low level of parasite population in the treatments, results obtained were not satisfactory. Renewed attempts will, however, be made to evaluate the effectiveness of the above insecticides on parasitic nematodes, plants and beneficial organisms in soil.

EXPERIMENT 4: Field Experiments with French Marigold — Var. Dwarf Double Willy.

Locality: Coffee Research Station, Balehonnur.

Started; July 1960.

Details: *Treatments:* 2—
A) Marigold + Coffee
B) Control (Coffee alone)

Replications: 6.

Plot size: $6\frac{1}{2} \times 6\frac{1}{2}$ surrounded by trenches.

Layout: Randomized.

Observations were in progress. Considerable difficulty was experienced to establish marigold in plots and hence the data obtained did not warrant evaluation and analysis at this stage.

3.8. *MISCELLANEOUS PESTS (Thrips, Hoppers, Mites):*

To evaluate the effect of various insecticides on the above pest species which may affect the foliage, branches, blossoms and fruits of coffee bringing about abnormalities and injury, two series of field experiments were started in early 1961. The details of each experiment are given below.

EXPERIMENT 1: Trials with W.L. 1650, Dieldrex, Malathion and Ekatox.

Locality: M. Block, Coffee Research Station, Balehonnur.

Started: April 1961.

Details: *Treatments:* 9—

A)	Dieldrex	18 E.C.	0.1 a.c.
B)	,,		0.2 a.c.
C)	Ekatox	50 E.C.	0.01 a.c.
D)	,,		0.02 a.c.
E)	Malathion	57 E.C.	0.01 a.c.
F)	,,		0.02 a.c.
G)	W.L. 1650	15 E.C.	0.1 a.c.
H)	,,		0.2 a.c.
I)	Control.		

Replications: 5 (One plant/replication).

Layout: Randomized.

Methods:

Initial spray with all the chemicals was imposed before blossoms opened followed by a second spray (C, D, E & F only) soon after blossoms opened. A renewed (third) spray with the latter four was imposed two weeks after and a fourth spray, comprising all the chemicals, a month after the initial (pre-blossom) spray. Further sequence of sprays were programmed at the following periods: treatments A, B, G & H once a month; treatments C, D, E & F twice a month; depending upon suitable weather conditions. On each plant, the following observations were scheduled for implementation:

(i) total number of primaries—initial,

(ii) condition of leaves—initial and once a month,

(iii) general condition of the plant—initial and once a month,

(iv) number of buds on three branches at three nodes each that are tagged—initial,

(v) extent of blossoming—before sprays with C, D, E & F,

(vi) extent of fruit set—two months after initial treatment on branches tagged (iv) 'in situ', and examination of fruits collected from bulk,

(vii) degree of insect incidence—twice a week or at convenient intervals depending upon weather and recording species-wise.

N.B: In control, two of the total three branches on each plant were kept covered in polythene bags for the period preceding blossoming and a few days after.

EXPERIMENT 2: Trials with PP. 175 (JF 703).

Locality: J. Block, Coffee Research Station, Balehonnur.

Started: April 1961.

Details: *Treatments:* 3—

A) PP. 175 70 W.P. 0.02 a.c.

B) „ 0.04 a.c.

C) Control.

Replications: 5 (One plant/replication).

Layout: Randomized.

Methods:

Sprays were programmed to be undertaken at fortnightly intervals from initial. At every spray operation, observations on the condition of foliage at two distal nodes (tagged) on each of the five selected branches per plant would also be recorded. Fruit samples would also be examined. Imposition of sprays in July and August 1961 would depend upon weather.

3.9. *STUDIES ON PHYTOTOXICITY:*

3.9.1. The phytotoxic effects on coffee, if any, produced by B.H.C., Dieldrin, Lindane and D.D.T. at various sequences, rates and methods of application, were being evaluated in four experiments in progress at the Coffee Research Stations. B.H.C. and Lindane were in test on potted young Arabica coffee plants at the Coffee Research Station, Balehonnur. Each chemical was applied as swab; the rates of application being, B.H.C. —8 and 16 lb. and Lindane—0.65 and 1.30 lb. in 40 glns. of water. The sequences of application ranged from one to six at monthly intervals. Observations on the condition of growth of plants were in progress. Analysis of plant material for residue of the insecticides, if any, was also programmed.

3.9.2. The experiment had already run its duration of six months (representing one to six applications of each insecticide at the specified rates). Data collected on the overall condition of the plants, so far, did not indicate any obvious phytotoxic effects irrespective of the treatments. Data on the rate of accumulation and break down of the insecticides in the plant system are still awaited.

3.9.3. A similar experiment with B.H.C. at the aforesaid rates was in progress at the Coffee Research Sub-Station, Chethalli, Coorg. Here, the sequences of application ranged from one to twelve, at monthly intervals.

3.9.4. A preliminary field trial with D.D.T. 50 W.P., & B.H.C. 50 W.P.—4 lb., 8 lb., and 16 lb.—and Dieldrin 50 W.P.—$\frac{1}{2}$ lb., 1 lb., and 2 lb.—in 40 glns. of water—was also in progress at the Coffee Research Station, Balehonnur. The insecticides were applied as drench to basket seedlings of Arabica coffee. Data obtained, so far, indicated that B.H.C., regardless of the dosage, produced phytotoxicity; the symptoms being chlorosis, clubbed root system, aborted tap root with scanty and malformed lateral roots and cellular damage subsequently leading to death of the plants in several cases. No such symptoms were apparent on plants in the other treatments to date. Further observations are in progress.

C. BASIC RESEARCH

4. Laboratory and Field Studies on the Habits and Ecological Relationships of Pests of Coffee:

4.1. RED BORER—*Z. Coffeae:*

4.1.1. Studies commenced earlier (Ann. Rep. 1959-60) were continued. Older larvae were found to change hosts often regardless of the condition of the plant hosts. This habit was common during summer months just prior to blossom showers and presented some difficulty in making field observations on larvae in caged plants. Higher degree of incidence of the species among young than old coffee was apparently determined by the habits of host selection by the adults. Studies on this aspect evidenced that the following coffee species could successfully harbour the pest species:—

(i) *Coffea stenophylla*;
(ii) *C. bengalensis*;
(iii) *C. zanquebariensis*;
(iv) *C. racimosa*;
(v) *C. eugenioides*;
(vi) *C. anuwumiensis*.

C. salvatrix was not acceptable to the species.

4.1.2. Studies to determine the life cycle of the species were also in progress. Due to the marked low level in pest population during the year, collections of the larvae were poor. Table XVIII gives the measurement of head widths of various groups of larvae, collected at different periods during 1960-61 (July—June) from the five selected blocks earlier mentioned.

4.1.3. As in the previous years, larvae having head widths between 2.5 mm. and 3.5 mm. were obtained in July, September, December and April—May from the selected blocks, though in the rest of the estate, such larvae were obtained during October, November, and March also. Correlating the above with the data in Table XIX showed that larvae, collected in February, March and April, having head widths 2.5 mm., 2.5 mm., and 3.5 mm. respectively, pupated around March—April in the same year after 4, 3 and 1 molt each, while those of October—November of the previous year with head widths at the time of collection, 3.5 mm. and 3.0 mm. reached pupation in the succeeding January—March period after 4 and 3 molts respectively. This prolonged larval life in the latter case could probably be attributed, among other factors, to the prevailing low temperatures in the period in question. Apparently, head widths of the larvae at the time of collection and the number of molts they passed through before pupation seemed to be unrelated and a tendency towards accelerated molts—hence fast rate of growth—existed in the February—March period of a year. It was also evident that at pupation, greater body dimensions were attained by larvae collected in October—November than the rest.

4.1.4. The duration and number of instars preceding pupation in the case of larvae, obtained in March—April, with head widths ranging from 0.5 mm.—0.75 mm.

would warrant further study. However, it could be possible that these larvae pass through various instars in the succeeding months to pupate around March—April of the next year.

4.1.5. The effect of temperature on the duration of the pupal stage which ranged from 17—35 days was quite apparent.

4.1.6. The above studies indicated the existence of only one emergence period per year for the moths. Attempts to induce mating among moths, in the laboratory, proved futile. Unmated moths began oviposition 24—36 hours after emergence. The period of oviposition was entirely from dusk to dawn and the maximum number of eggs laid by a female in the laboratory was 643. The average duration of longevity of a female was 7 days.

4.2. SHOT HOLE BORER—*X. morstatti:*

4.2.1. Studies on the habits, life history and ecological relationships of the species were conducted in the laboratory. Fertilized females burrowed into tertiary branches, preferring the underside of the twigs as sites. Sides and nodes of twigs were significantly less attacked.

4.2.2. The burrow, to begin with, was at right angles to the twig but on reaching the medullary region ran lengthwise in the twig. Lengthening of the burrow continued along with ovipositions; the latter ranging from two to three weeks in duration. This might explain the usual occurrence of the various stages of the species within a tunnel.

4.2.3. In the laboratory, the average number of eggs laid by a mated female was 21 with a range from 12 (in 6 days) to 28 (in 9 days). The incubation period lasted on an average 7.6 days with a range of 7—8 days in duration. There were three larval instars, the first instar taking an average duration of 4 days (range 3—4); the second instar 4.2 days (range 4—5) and the third instar 11.25 days (range 11—12). The average duration of the pre-pupal stage that followed was 4 days and that of the pupal stage 7 days. Adult females without food lived for 10 days on an average with a range of 8—13 days. Table XX gives the duration of the stages in the life history in relation to temperature and relative humidity.

4.2.4. The maximum number of adults noticed in a tunnel was 21 (female:male =20:1) in the January—February period while the minimum number was 11 (8:3) in the same period. The sex ratio in the population for the January—February period was 5 females to 1 male.

4.3. DADAP BORER—*Pothyne moringae Auriv* (*Coleoptera, Cerambycidae*):

4.3.1. Studies were commenced in January 1960 at the Coffee Research Station, Balehonnur. Tracings were undertaken to assess the intensity of incidence during various periods, *viz.*, January 1960—May 1960 and September 1960—May 1961. The blocks traced were 17 acres (NMS III and 49 clearings), NMS V, 8 acres, M, L_2 Seed and 1955 Seed. It was found that M and 17 acre blocks had greater degree of incidence than the rest and among the months, October—November evidenced maximum incidence.

4.3.2. Damage to dadap (*Erythrina lithosperma*) was confined mainly to the branches and it was not uncommon to find an infested branch bored right through its length. A small hole at the distal end of the branch led into the tunnel. A bored branch appeared wilted, especially toward the distal end, and possessed yellow drooping leaves.

4.3.3. The external morphology, habits and life history of the species were studied in some detail. The latter two aspects are dealt with below.

4.3.4. The larvae, collected in the field (5-30 mm. in length) were cultured in cut dadap branches, 60-80 mm. long kept in glass vials of 100×25 mm. dimensions. The vials were stoppered with cotton wads. Fresh host material was supplied daily except in the case of the larvae commencing pre-pupal stage. The adults were kept with host material in bell jars.

4.3.5. To begin with, larvae in the field were found to confine tunnelling and feeding in the pith region of the host branch. Gradually, with the advancement in development, progressive tunnelling took place towards the harder parts of the branch, finally enveloping the condensed pith region and cortex. Laboratory observations on the habits of larvae belonging to various instars substantiated the above observations except that they did not accept highly succulent branches for the purpose of tunnelling and feeding.

4.3.6. Movements of the larva was often accomplished on its body sides by means of the ampullae. Preceding each molt, the larva underwent a period of inactivity extending 24—48 hours in duration. The process of ecdysis took approximately 30 minutes and feeding was resumed only 4—6 hours later. Preliminary laboratory observations also suggested that twigs of Arabica coffee were readily acceptable to the larva though the rate of boring was significantly slow.

4.3.7. In the laboratory, the smallest of the larvae reared (length—6 mm.) underwent 7 molts while those ranging from 9 mm. to 18.9 mm. in length underwent 5—8 molts. The larval stage ranged from 92—143 days in duration; from the dates of collections falling in October and November 1960.

4.3.8. The pre-pupal stage was reached in the tunnel prepared by the larva, the latter having the form of a hollow cylinder plugged at both ends with compact masses of gnawed strips of wood and excreta. The pre-pupa, when disturbed, exhibited rapid movements on its dorsum. This stage ranged from 4—10 days with an average of 5.8 days in duration.

4.3.9. The process of transformation of the pre-pupa into pupa lasted approximately 30 minutes. Gradual changes in colour of the pupa were apparent at first on the mandibles and on the rims of the eyes followed by darker shades enveloping the entire body. The pupal stage ranged from 9—12 days in duration; the average being 9.8 days.

4.3.10. As the time for adult emergence approached, the pupal skin was observed to rupture along the dorsal part of the head and thorax. Through this rupture, the anterior region of the adult was protruded out; the insect gradually pushing the pupal skin backward through the movements of its body and hind legs. On emergence, the adult usually remained within the tunnel for 24—48 hours (in one case, larva collected in May trans-

formed into adult in July and remained in tunnel for 12 days) before it made its escape to outside.

4.3.11. In the field, adults were often observed to emerge in late May—June. An explanation for the lapse of nearly three months between emergence of adults in May—June and the appearance of small larvae in October—November, in the field, was sought. It was presumed that pupae that transformed to adults in looped, dried dadap branches during the monsoon would tide over the prevalence of unfavourable conditions—which included insufficient host material—by remaining for a longer period within the bored branches. With the advent of favourable environmental conditions in September they would commence fresh infestations. The case stated above, where an adult that emerged in July remained within the tunnel for 12 days before flying out, might point out to such a tendency existing in the field for longer durations.

4.3.12. Adults reared in the laboratory were not noticed to feed on dadap branches given to them while those collected in the field readily fed on the tender parts of the branches. Such feeding resulted in longitudinal lacerations on the epidermis of the host. Attempts to study the courting, mating and oviposition habits of the adults were unsuccessful due to the absence of simultaneously emerged sexes. The range of longevity of the adult was 1—18 days with an average of 7.75 days in duration. There was apparently no difference in longevity between the sexes.

5. Studies on the Abundance and Activity of Predators and Parasites of Pests of Coffee:

5.1. GREEN BUG—*C. viridis:*

Among the parasites collected from the green bug, *Cheiloneuromyia javensis* Grlt. (Hym. Encyrtidae) appeared predominant. *Coccophagus bogoriensis* Koening. (Hym. Eulophidae) and *Coccophagus* sp. were also present.

5.2. SHOT HOLE BORER—*X. morstatti:*

Insects associated with the shot hole borer consisted of the following:—

(a) Tubiliferous thrips (F. Phloeothripidae); of two genera; predacious on eggs and larvae;

(b) Mites (not identified) probably predacious on eggs and larvae;

(c) Formicids (*Tetraponera* sp.) predacious on larvae.

The above species were active during early 1961 and probably this activity played an important role in checking the increase of shot hole borer which as already stated showed considerable waning beginning from early 1961. Also, this latter phenomenon perceptible in every season could possibly be related, among other factors, to the increased activity of natural enemies.

5.3. RED BORER—*Z. coffeae:*

Incidence of *Amyosoma* sp. (Hym. Braconidae) was perceptible as in the previous year.

The white fungus, *Beauveria bassiana* Bals. was found widely distributed, the incidence being marked from May to July. Artificial inoculation tests were conducted in the laboratory to obtain preliminary data on the mode and progress of infection on red borer larva. It was noticed that the activity of the host larva ceased in about 5 to 7 days from inoculation and paralysis followed by death occurred in 8 to 10 days. Fluffy mycelial growth was visible in a majority on the eighth day from inoculation and sporulation of the fungus took place three days thereafter especially at the intersegmental membranes. The host body became completely mummified within a week of sporulation.

5.4. DADAP BORER—*Terastia meticulosalis* G.:
(Lep. Pyralidae)

Several branconids (*Apanteles* spp.) were recorded.

5.5. SHOOT MEALY BUG—*Planococcus* sp.?:
(Hem. Hom. Coccidae)

The drosophilid, *Gitona perspicax* Knab., whose larvae are predacious on the shoot mealy bug, was obtained.

6. Collection, Identification and Preservation of Insects:

6.1. Insect specimens obtained from various sources—including those mentioned above—are entered in Table XXI.

6.2. Studies to determine the comparative abundance of insect species in the estate at the Coffee Research Station, Balehonnur, were continued. The trap instituted at NMS V Block functioned throughout the year while that at J. Block till the end of 1960. As in previous seasons, Diptera predominated in the collections from both traps (Table XXII).

6.3. Analysis of data obtained for the periods April 1959 (commencement) to March 1960 and April 1960—March 1961, in the case of the trap in NMS V Block gave the following information:—

(i) There was high significance at both levels, between populations of insect orders in both the periods wherein Diptera ranked high. Coleoptera, Hymenoptera, Hem. Homoptera and Heteroptera, and Lepidoptera followed next in order. There was, in general, no significant difference between the populations of other orders. Combined analysis for the total period also showed the same trend.

(ii) There was no significant difference between months in both periods.

(iii) Between the two periods there was no significant difference.

6.4. Further analysis of the data on hand—and to be collected—will be attempted to determine the effect of height of light source and funnel distance, if any, on insect catches.

7. Studies on Nematodes:

7.1. Observations on the distribution of various nematode species in coffee plantations and on their relative pathogenecity were continued. The species and their locations are given in Table XXIII.

7.2. Among the species, *Rotylenchulus* was found predominant and widely distributed. Field evidence suggested, for the first time, that this specie attacked the roots of *Coffea Arabica* Linn. Other dominant species recorded were, *Xiphinema americanum* Cobb., *Pratylenchus coffeae* Zimm., *Helicotylenchus nannus* Steiner, *H. multicinctus* Golden, *H. erythrinae* (Zimm.) Golden, *Hoplolaimus* sp., *Tylenchorhynchus* sp., *Hemicriconemoides* sp., *Aphelenchus* sp., *Tylenchus* sp., *Aphelenchoides* sp., and *Tylencholaimus* sp. The former eight species were detected in soil and in degenerated roots of unhealthy Arabica coffee. The latter two species occurred in soil and in apparently healthy roots of Arabica coffee. *H. multicinctus*, *Hemicriconemoides* sp., *Aphelenchus* sp., *Tylenchus* sp., *Aphelenchoides* sp., and *Tylencholaimus* sp. are apparently new records in coffee plantations in India.

7.3. Root Knot Nematodes were obtained from the roots of *Erythrina lithosperma*. They included *Meloidogyne* sp. and another which appeared to be *Meloidogyne arenaria* ssp. *thamesi*.

7.4. Predators detected were *Mononchus* spp. and *Dorylaimus* spp.

7.5. Investigations were in progress to detect the association of *Rotylenchulus* sp., if any, with the commonly occurring weeds at the Coffee Research Station, Balehonnur. It was seen that roots of spanish needle, *Bidens pilosa*, harboured these parasites. Studies were also commenced to ascertain the reaction of the species to the roots of *Crotalaria* sp. and *Tagetes* sp.

7.6. Specimens of *Rotylenchulus* collected during various seasons of the vear comprised comparatively of large populations of larvae and immature females. Males were less in number though their number showed gradual increase by the commencement of monsoon. Adult females could not be traced so far in the field. During the course of observation all gradations of infection/population were met with in a season. It was not uncommon to find vigorous to less vigorous coffee (Arabica) in localities infected with high populations of *Rotylenchulus* while in several other localities the plants exhibited distress at obviously lower levels of parasite population. Young plants (supplies) showed a greater degree of susceptibility to infection than old ones.

7.7. The rate of increase in the parasite population was found greatest at low initial levels and this dwindled at higher initial levels. These field observations, when correlated, would indicate that availability of suitable and healthy host material (Arabica coffee and weeds such as spanish needle) in an optimum environment promoted the increase of parasites in an infected locality. Coffee plants might withstand the infection if their vigour of growth was kept sustained. The intensity and rate of progress of the host vigour decline would also appear to control the level of parasite population around roots.

7.8. In plantations where there was an obvious correlation between the decline in growth of coffee (Arabica) and build-up in the population of *Rotylenchulus* sp., the predator population (comprised of *Mononchus* spp.) detected in the soil was significantly lower than the parasite population. Also, some plantations which once had high parasite but low predator population, with the resultant poor growth of coffee, did exhibit signs

of improvement in the course of further observations. Incidentally, this recovery appeared related to a steady improvement in the level of predator population, promoted in several cases by the addition of decomposed cattle manure. At least in a few cases, where pathogenic fungi, *Fusarium* sp. and *Rhizoctonia* sp., were encountered in aborted or malformed root system, the number of parasite species appeared less than that found in cases of root infection without fungus association.

7.9 Critical studies in aseptic conditions to examine the interrelationships between fungi and nematodes infecting coffee, in general, are contemplated.

7.10. The degrees of susceptibility manifested by varieties of Arabica coffee were not conclusively ascertained. Also, no conclusive evidences were yet available to substantiate the variations in the infective potential that might exist between and/or within species of *Rotylenchulus*. The relative pathogenecity of *Xiphinema* spp., *Pratylenchus coffeae* and *Helicotylenchus* spp. and other nematodes in various ecological conditions would warrant detailed study.

P. SOMASEKHAR,
Entomologist

TABLE I

Incidence of Shot Hole Borer — X. MORSTATTI — at the Coffee Research Station

(August 1957 — July 1961 comparative)*

Year	Particulars	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Total Rainfall
1956–57	Av. Max. Temp. (°C.)	22.8	23.6	25.0	25.7	26.1	27.2	29.1	30.6	31.9	30.5	25.7	22.4	
	Av. Min. Temp. (°C.)	18.2	17.9	17.8	17.2	14.4	14.3	15.1	17.2	19 8	19,7	19.4	18.6	
	Av. R. Hum.	95	94	95	88	80	81	77	79	87	86	94	96	
	Rainfall (Inches)	19.96	6.26	12.46	4.13	—	—	—	0.06	3.34	6.69	14.95	37.25	105.10
1957–58	Incidence (%)	4.8	9.2	5.66	17.73	17.8	7.5	6.8	4.06	1 53	2.6	3.6	3.66	
	Av. Max. Temp. (°C.)	20.7	25.1	26.4	26.2	26.8	27.3	29.1	31.2	30.8	26.9	26.6	22.4	
	Av. Min. Temp. (°C.)	18.4	17.4	18.6	17.6	16.0	14.7	15.1	18.2	19.5	20.1	19.0	18.3	
	Av. R. Hum.	95	93	94	88	86	81	77	71	85	95	93	94	
	Rainfall (Inches)	23.14	2.44	17.30	7.27	0.05	0.04	—	1.18	8.01	5.21	20.35	50.49	135.48
1958–59	Incidence (%)	7.13	8.53	9.06	11.26	12.8	10 0	6.26	2.27	0 86	0.8	0.66	0.8	
	Av. Max. Temp. (°C.)	23.2	24.2	26.2	26.3	26.4	28.5	30.2	32.4	31.9	30.6	25.7	21.9	
	Av. Min. Temp. (°C.)	19.0	18.3	17.3	16.7	15.7	15.4	16.4	18.0	19.9	20 0	19.0	18.5	
	Av. R. Hum.	95	92	88	90	85	93	88	82	89	91	94	95	
	Rainfall (Inches)	23.44	6.61	5.42	1.22	—	—	—	—	2.46	4.96	25.57	67.65	137.33
1959–60	Incidence (%)	0.93	1.66	3.66	5.0	5.86	7.46	8.73	4.6	4.2	3.46	7.2	8.06	
	Av. Max. Temp. (°C.)	22.8	23.9	26.4	25.8	26.6	27.9	29.9	31.1	30.5	29.2	24 3	23.7	
	Av. Min. Temp. (°C.)	18.7	18.7	17.8	16.9	15.7	15.6	15.8	17.7	19.2	19.9	18.9	18.9	
	Av. R. Hum.	95	95	94	89	81	82	67	93	93	93	93	95	
	Rainfall (Inches)	21.10	13.70	5.44	0.78	0.39	—	—	1.77	9.61	3.91	14.19	41.03	111.92
1960–61	Incidence (%)	6.53	6.73	8.53	5.13	7.00	5.33	4.13	3.06	2.26	2.13	1.46	1.73	
	Av. Max. Temp. (°C.)	22.5	24.2	26.0	24.9	27.1	27.3	29.6	32.7	31.6	27.9	24.9	21.8	
	Av. Min. Temp. (°C.)	18.6	18.3	17.2	16.9	14.3	15.3	15.4	17.8	19.2	19.0	18.5	18.2	
	Av. R. Hum.	94	95	93	92	81	82	81	84	93	94	95	97	
	Rainfall (Inches)	19.83	9.90	11.46	6.73	—	—	—	0.84	5.08	14.49	22.22	71.73	162.28

*** Perecent infested twigs in 1500 twigs examined per month.**

TABLE II

Incidence of Red Borer—Z. COFFEAE—In the Selected Blocks and in the Rest of the Estate at the Coffee Research Station (July 1960—June 1961)

Sl. No.	Blocks	Area (acres)	July 1960	Aug.	Sept.	Oct.	Nov.	Dec.	Jan. 1961	Feb	March	April	May	June	Total	Per acre
1.	N.M.S. IV	0.82	1	—	—	—	—	—	—	1	3	—	—	—	5	(*approx.*) 5 plants
2.	N.M.S. V	2.06	1	—	1	—	—	1	—	—	—	6	4	—	13	6-7 plants
3.	L_2 Seed	5.25	5	—	—	—	—	—	—	—	2	—	1	—	8	2 plants
4.	1955 Seed	4.22	—	1	—	—	—	1	1	2	4	5	2	2	18	4 plants
5.	J	2.24	1	—	1	—	—	—	—	—	—	2	1	—	5	2 plants
	Total	14.59	8	1	2	—	—	2	1	3	9	13	8	2	49	3 plants
	Rest of the Estate	87.59	No Trac-ing	2	—	2	No Trac-ing	No Trac-ing	No Trac-ing	No Trac-ing (1 casual)	5	22	5	No Trac-ing	38	Less than 1 plant/ acre
	Grand Total	102.18	8	3	2	2	—	2	1	4	14	35	13	2	87	1 plant

TABLE III

Effect of Various Sequences of B.H.C. Swabs on Cup Quality

Sl. No.	Block	Particulars	Cup Quality 1960			Cup Quality 1961			Remarks
			Kenya (Parchment)	London (Clean)	Hamburg (Clean)	Kenya (Parchment)	London (Clean)	Hamburg (Clean)	
1	R	No swab in either seasons — beginning from April 1959 swab	Very sour	Falling off	f. a. q.	Very poor	—	—	
2	L_1	No swab in October — beginning from April 1959 swab	Sour	Falling off	f. a. q.	Very poor	—	—	
3	Q	No swab in April — beginning from October 1959 swab	Bricky (samples represent 2 swabs)	Falling off	f. a. q./ falling off	Sour	—	—	
4	Old (Bulk) (behind S 45 × K)	Two swabs — April-May & Sept.–Oct. seasons	— Samples not sent —			Slightly bricky (samples represent 2 swabs)	—	—	

Note :— Results are awaited from London and Hamburg on 1961 test.

TABLE IV

Comparative Incidence of White Stem Borer — X. QUADRIPES — in the Selected Blocks (Swabbed in Different Seasons and Unswabbed) — April 1958 — March 1961

Blocks	*R. Block* No swab in both seasons beginning from April 1959—4.97 acres			*L_1 Block* No swab in October every year beginning from April 1959 swab—2.43 acres			*Old Block* Behind S 45 × K Block Bulk—Two swabs—April-May and Sept.-Oct. seasons—1.59 acres			*Q Block* No swab in April every year beginning from October 1959 swab—2.00 acres	
Period of Observations	Before beginning the experiment—April 1958 to March 1959	After beginning the experiment—April 1959 to March 1960	After beginning the experiment—April 1960 to March 1961	Before beginning the experiment—April 1958 to March 1959	After beginning the experiment—April 1959 to March 1960	After beginning the experiment—April 1960 to March 1961	April 1958 to March 1959	April 1959 to March 1960	April 1960 to March 1961	Before beginning the experiment—April 1959 to March 1960	After beginning the experiment—April 1960 to March 1961
Incidence (Plants)											
Total	12	10	7	10	5	51	30	9	4	35	14
Per acre	2.4	2.0	1.4	4.0	2.0	20.4	20.0	6.0	2.6	17.5	7.0
Plant material	Old Kents, 30–35 Yrs.			Old Kents, 20–25 Yrs. & S-333, 8–10 Yrs.			As in R			As in R	

TABLE V

Effect of Insecticides on the Green Bug — C. VIRIDIS
(Low concentration — 0.02 a. c.)

Treatments	Mean percentage reductions obtained at								
	10 days after treatment			20 days after treatment			30 days after treatment		
	Adults	Nymphs	Total	Adults	Nymphs	Total	Adults	Nymphs	Total
A Basudin	89.48	86.05	88.93	87.00	78.20	78.98	87.31	98.36	97.55
B Malathion	92.03	89.57	90.18	90.08	93.60	93.43	96.48	98.76	98.55
C Paramar	100.00	100.00	100.00	99.20	100.00	95.40	100.00	100.00	100.00
D Fosferno	100.00	100.00	100.00	99.26	99.81	99.80	100.00	100.00	100.00
G Meta-iso-Systox	79.73	85.90	85.90	80.68	91.38	90.58	98.71	99.60	99.51
H Ekatin	87.25	83.17	86.67	86.08	88.86	88.58	94.30	99.63	99.10
I Ekatox	100.00	99.72	99.75	95.48	94.26	94.26	99.61	100.00	99.90
J Rogor	71.72	57.43	61.28	70.41	53.65	57.13	91.70	100.00	98.78
K Control	—	—	—	—	—	—	—	—	—
General mean	80.02	77.98	79.19	78.68	77.75	77.57	85.35	88.48	88.14
S.E.M.	3.82	7.06	6.13	5.02	7.51	7.32	2.41	2.4	3.60
Critical difference	10.26	9.98	16.30	14.20	21.20	20.60	6.80	6.8	10.20
Significance	Yes**	Yes**	Yes**	Yes**	Yes**	Yes**	Yes**	Yes**	Yes**
Conclusion	(CD) I BAGH JK			DCIBAHGJK		DCIBGHAJK	(CDIJ) HGBAK		
	(CDI) B AHG JK		(CD) IBAHGJK		CDIBGHAJK		(CD) IGBHJAK		(CD) IGHJBAK

N.B.:—Alphabets in brackets have similar numerical values.
** Significant at 1% level.

TABLE VI

Effect of Insecticides on the Green Bug — C. VIRIDIS
(High concentration — 0.04 a.c.)

Treatments	Mean percentage reductions obtained at								
	10 days after treatment			20 days after treatment			30 days after treatment		
	Adults	Nymphs	Total	Adults	Nymphs	Total	Adults	Nymphs	Total
A Basudin	83.18	82.60	85.31	82.66	86.56	88.30	96.33	98.77	96.78
B Malathion	80.91	87.56	87.31	84.88	96.40	95.86	96.28	100.00	99.90
C Paramar	100.00	100.00	100.00	95.60	97.34	97.56	100.00	100.00	100.00
D Fosferno	100.00	100.00	100.00	88.45	96.50	99.30	98.50	100.00	99.92
G Meta-iso-Systox	55.71	83.35	80.55	68.83	86.36	83.21	83.73	90.60	89.95
H Ekatin	73.16	92.53	89.16	82.16	90.50	88.63	95.58	96.52	96.48
I Ekatox	100.00	100.00	100.00	100.00	96.20	99.56	100.00	100.00	100.00
J Rogor	79.43	86.40	86.50	69.26	71.45	72.56	90.23	92.43	92.30
K Control	—	—	—	—	—	—	—	—	—
General Mean	74.71	81.38	81.03	74.65	79.03	79.44	84.51	86.48	86.14
S.E.M.	5.85	5.61	4.53	4.49	6.55	5.19	2.64	2.56	2.48
Critical difference	15.71	15.06	11.16	12.08	17.67	13.87	6.89	6.85	6.65
Significance	Yes**	Yes**	Yes**	Yes**	Yes**	Yes**	Yes**	Yes**	Yes**
Conclusion	(CDI) ABJHGK	(CDI) HBJAGK	CDBIHAGJK	(CI) DABHJGK	(CI) DBAHJGK				
	(CDI) HBJGAK	ICDBAHJGK	IDCBHAGJK	(BCDI) AHJGK					

N.B.:—Alphabets in brackets have similar numerical values.

** Significant at 1% level.

TABLE VII

Comparative Effectiveness of Low and High Concentrations of Chemicals in the First Group (Tables V & VI) at Similar Periods
(Adults)

Treatments	Mean percentage reductions obtained at 10 days low conc. Vs. 10 days high conc.	Treatments	Mean percentage reductions obtained at 20 days low conc. Vs. 20 days high conc.	Treatments	Mean percentage reductions obtained at 30 days low conc. Vs. 30 days high conc.
Low concentration (0.02 a.c.)		**Low concentration (0.02 a.c.)**		**Low concentration (0.02 a.c.)**	
1 C Paramar	100.00	1 D	99.26	1 C	100.00
2 D Fosferno	100.00	2 C	99.20	2 D	100.00
3 I Ekatox	100.00	3 I	95.48	3 I	99.61
4 B Malathion	92.03	4 B	90.08	4 G Meta-iso-Systox	98.71
		5 A Basudin	87.00	5 B	96.48
		6 H Ekatin	86.08	6 H	94.30
High concentration (0.04 a.c.)		**High concentration (0.04 a.c.)**		**High concentration (0.04 a.c.)**	
5 C Paramar	100.00	7 I	100.00	7 C	100.00
6 D Fosferno	100.00	8 C	95.60	8 I	100.00
7 I Ekatox	100.00	9 D	88.45	9 D	98.50
				10 A	96.33
				11 B	96.28
				12 H	95.58
General Mean	98.86		94.57		97.98
S.E.M.	1.3		2.52		1.3
Critical difference	3.75		6.97		3.75
Significance	Yes**		Yes**		Yes**
Conclusion	(123567) 4		71283 4956		(1278) 3495,10,11,12,6

N.B.:—Numerals in brackets have similar values.

** Significant at 1% level.

TABLE VIII

Comparative Effectiveness of Low and High Concentrations of Chemicals in the First Group (Tables V & VI) at Similar Periods

(Nymphs)

Mean percentage reductions obtained at									
	Treatments	10 days low conc. Vs. 10 days high conc.		Treatments	20 days low conc. Vs. 20 days high conc.		Treatments	30 days low conc. Vs. 30 days high conc.
Low concentration (0.02 a.c.)			**Low concentration (0.02 a.c.)**			**Low concentration (0.02 a.c.)**		
1	C Paramar	100.00	1	C	100.00	1	C	100.00
2	D Fosferno	100.00	2	D	99.81	2	D	100.00
3	I Ekatox	99.72	3	I	94.26	3	I	100.00
			4	B	93.60	4	J	100.00
High concentration (0.04 a.c.)			5	G Meta-iso-Systox	91.38	5	H	99.63
4	C Paramar	100.00	6	H	88.86	6	G	99.60
5	D Fosferno	100.00				7	B	98.76
6	I Ekatox	100.00	**High concentration (0.04 a.c.)**			8	A	98.36
7	H Ekatin	92.53	7	C	97.34	**High concentration (0.04 a.c)**		
8	B Malathion	87.56	8	D	96.50	9	B	100.00
9	J Rogor	86.40	9	B	96.40	10	C	100.00
			10	I	96.20	11	D	100.00
			11	H	90.50	12	I	100.00
			12	A Basudin	86.56	13	A	98.77
			13	G	86.36	14	H	96.52
	General Mean	96.24			93.66			99.35
	S.E.M.	3.05						.71
	Critical difference	8.44						1.96
	Significance	Yes**			No			Yes*
	Conclusion	(12456)3789			1,2,7,8,9,10,3,4,5,11,6,12,13			(1,2,3,4,9,10,11,12)5,3,13,7,8,14

N.B.:—Numerals in brackets have similar values.

* Significant at 5% level.

** Significant at 1% level.

TABLE IX

Effect of Paramar, Fosferno and Gusathion on the Green Bug — C. VIRIDIS

	Treatments	Corrected mean per cent effectiveness at			
		10 days after treatment	15 days after treatment	25 days after treatment	35 days after treatment
D	Paramar 0.01 a.c.	70.98	98.09	98.34	97.52
E	„ 0.02 a.c.	85.95	96.89	99.55	99.69
F	„ 0.04 a.c.	83.93	96.96	100.00	100.00
G	Fosferno 0.01 a.c.	79.83	96.19	99.24	100.00
H	„ 0.02 a.c.	78.33	92.94	100.00	100.00
I	„ 0.04 a.c.	79.25	91.85	100.00	100.00
J	Gusathion 0.01 a.c.	87.48	95.99	93.08	95.32
K	„ 0.02 a.c.	57.14	95.90	82.98	81.03
L	„ 0.04 a.c.	70.52	97.34	90.86	76.50
	General mean	77.05	95.79	96.01	94.45
	S.E.M.	—	1.10	1.85	5.43
	Critical difference	—	3.29	5.56	16.28
	Significance	No	Yes**	Yes**	Yes**
	Conclusion	—	DLFEGJK HI DLFE > HI	(FHI) EGDJLK ——> K	(FGHI) EDJKL K > L FGHIED > KL J > L

N.B.:—Alphabets in brackets have similar numerical values.

** Significant at 1% level.

TABLE X

Effect of Insecticides — With and Without Bordeaux Mixture — on the Incidence of Shot Hole Borer — A. MORSTATTI

	With Bordeaux Mixture				Without Bordeaux Mixture			
	Treatments	Mean per cent infestation (tunnels) in			Treatments	Mean per cent infestation (tunnels) in		
		November	December	January		November	December	January
A	Dieldrin 0.2 a.c.	1.83	3.00	2.66	A	2.66	6.66	2.50
B	„ 0.4 a.c.	1.00	2.17	3.16	B	4.00	3.66	3.00
C	Gusathion 0.05 a.c.	2.17	3.50	2.16	C	5.00	4.16	2.50
D	„ 0.1 a.c.	2.50	3.83	3.66	D	3.83	5.16	2.33
E	Control	9.83	8.83	5.66	E	7.83	9.50	2.83
					F W.L. 1650 0.05 a.c.	4.66	5.00	1.66
					G „ 0.1 a.c.	5.16	5.16	1.66
	General mean	3.46	4.26	3.46		4.73	5.61	2.35
	S.E.M.	1.42	0.81	0.63		—	—	—
	Critical difference	4.16	2.37	1.87		—	—	—
	Significance	Yes**	Yes**	Yes**		No	No	No
	Conclusion	BACDE	BACDE	CABDE		—	—	—

** At 1%

TABLE XI

Effect of Insecticides — With and Without Bordeaux Mixture — on Shot Hole Borer — X. MORSTATTI

Treatments	With Bordeaux Mixture			Treatments	Without Bordeaux Mixture		
	November (Mean per cent reduction from initial **)	December (Corrected mean per cent effectiveness **)	January		November (Mean per cent reduction from initial **)	December	January
A Dieldrin 0.2 a.c.	66.39	61.96	58.28	A	52.03	46.29	36.84
B „ 0.4 a.c.	64.18	77.99	47.63	B	28.24	45.63	40.08
C Gusathion 0.05 a.c.	26.38	41.41	54.59	C	56.59	63.52	67.14
D „ 0.1 a.c.	32.28	27.26	28.16	D	39.31	63.47	58.36
E Control	11.49	—	—	E	31.48	43.17	62.54
				F W.L. 1650 0.05 a.c.	13.30	34.01	39.12
				G „ 0.1 a.c.	25.90	49.61	55.94
General mean	40.14	52.16	47.16		35.26	49.39	51.43
S.E.M.	13.90	11.03	6.04		—	—	—
Critical difference	40.99	33.24	18.20		—	—	—
Significance	Yes*	Yes*	Yes*		No	No	No
Conclusion	$\underline{ABDCE}$	$\underline{BA\ CD}$	$\underline{AC\ BD}$		—	—	—
	A > E	B > C & D	ACB > D				
	B > E	A > D					

** Transformed figures — Angle = Arc Sin $\sqrt{\text{Percentage}}$.

* At 5%.

TABLE XII.

Effect of Insecticides on the Root Mealy Bug — P. CITRI

Treatments		Mean percentage bug populations recorded at					
		Low(l) concentration (0.02 a.c.)			High(h) concentration (0.04 a.c.)		
		7 days after treatment	10 days after treatment	15 days after treatment	7 days after treatment	10 days after treatment	15 days after treatment
A	Fosferno	41.63	27.06	29.16	29.83	25.00	27.77
B	Paramar	58.33	41.63	35.40	27.77	25.00	25.00
C	Basudin	54.13	37.50	39.56	29.17	29.17	27.06
D	Dieldrin	56.23	47.90	43.73	48.43	35.40	38.16
E	Ekatox	50.00	47.90	54.96	33.33	27.76	39.43
F	Malathion	77.06	65.36	47.90	61.40	49.96	40.93
G	Gusathion	77.06	72.90	82.03	51.33	45.10	43.03
H	W.L. 1650	39.56	29.13	35.40	38.17	31.93	36.10
I	Control	100.00	100.00	100.00	100.00	100.00	100.00
	General mean	61.55	52.15	52.01	46.60	41.03	41.94
	S.E.M.	4.65	6.66	8.30	4.88	3.04	4.82
	Critical difference	13.78	18.71	24.80	14.62	8.90	6.82
	Significance	Yes**	Yes**	Yes**	Yes**	Yes**	Yes**
	Conclusion	HAECDBFGI	ABHCDFEGI		ABECHDGFI		
		AHCBDEFGI		BCAEHDGFI		BCAHDEFGI	

Extended analysis (First group)

	7 days low Vs. 7 days high	10 days low Vs. 10 days high	15 days low Vs. 15 days high
General mean	36.18	30.46	34.54
S.E.M.	—	3.25	—
Critical difference	—	9.73	—
Significance	No	Yes*	No
Conclusion		$A_{(h)}B_{(h)}A_{(l)}E_{(h)}H_{(l)}C_{(h)}H_{(h)}C_{(l)}B_{(l)}$	

** At 1%.

* At 5%.

TABLE XIII

Effect of Insecticides on Aphids

Treatments	Mean per cent mortality at 12 hrs. after treatment
A Endrin 0.01 a.c.	62.20
B „ 0.02 a.c.	65.92
C Malathion 0.01 a.c.	99.97
D „ 0.02 a.c.	100.00
E W.L. 1650 0.01 a.c.	100.00
F „ 0.02 a.c.	93.05
G Paramar 0.01 a.c.	100.00
H „ 0.02 a.c.	100.00
I Folidol 0.01 a.c.	100.00
J „ 0.02 a.c.	100.00
K Control	—
General mean	83.74
S.E.M.	4.65
Critical difference	13.20
Significance	Yes**
Conclusion	(DEGHIJ) CF $\overline{BA}$ K

** At 1%.

N.B.:—Alphabets in brackets have similar numerical values.

TABLE XIV

Effect of Insecticides on the Hairy Caterpillar — EUPTEROTE sp. (Laboratory)

Treatments	Mean percentage mortalities obtained at							
	Low concentration (0.02 a.c.)				High concentration (0.04 a. c.)			
	4 hours after treatment	8 hours after treatment	24 hours after treatment	48 hours after treatment	4 hours after treatment	8 hours after treatment	24 hours after treatment	48 hours after treatment
A Basudin	27.73	49.96	49.96	55.50	88.86	88.86	100.00	100.00
B Paramar	11.10	22.22	61.06	66.60	49.93	77.40	88.86	88.86
C Gusathion	22.20	38.83	38.83	66.63	66.63	72.20	77.40	83.30
D Dieldrex	11.10	11.10	16.63	22.20	11.10	11.10	44.40	49.96
E Ekatox	11.10	27.73	61.10	72.16	38.86	49.96	77.76	88.86
F Folidol	33.30	44.40	66.63	72.20	44.43	50.00	77.73	100.00
G Malathion	—	—	11.06	16.63	11.10	11.10	11.10	16.63
H Meta-iso-Systox	11.10	22.20	33.30	44.40	16.63	38.86	61.06	77.73
I Ekatin	16.63	16.63	22.16	33.30	88.86	88.86	100.00	100.00
J W.L. 1650	—	—	11.06	88.86	22.16	33.30	61.06	100.00
K B.H.C.	—	—	—	5.53	—	5.53	5.53	16.63
L Control	—	—	—	—	—	—	—	—
General Mean	12.01	19.42	30.98	45.33	36.54	43.93	58.74	68.49
S.E.M.	—	11.01	9.50	9.40	8.80	9.60	8.18	6.40
Critical difference	—	32.23	27.85	27.56	25.80	28.14	23.90	18.74
Significance	No	Yes*	Yes**	Yes**	Yes**	Yes**	Yes**	Yes**
Conclusion		AFCEHBIDGJKL		JFECBAHIDGKL		AIBCFE HJ DGKL		AFIJBEC HDGKL
		FEBACHIDGJKL		AIC BFE J HDGKL		AIBEFCHJDGKL		

* At 5%.
** At 1%.

TABLE XV (a)

Effect of Nematicides, Soil Amendments and Farmyard Manure on Nematodes — Parasites

(December 1958 — January 1960)

Year/Month	Treatments	Depth counts average		Total
		0–12″	12–24″	
December 1958	A	38.8	27.2	66.0
	B	6.8	11.0	17.8
	C	14.4	32.4	46.8
	D	25.0	23.0	48.0
	E	11.6	9.0	20.6
	F	9.0	25.2	34.2
	Total	105.6	127.8	233.4
February 1959	A	6.0	1.6	7.6
	B	7.6	12.6	20.2
	C	6.6	41.2	47.8
	D	1.4	2.8	4.2
	E	3.2	2.4	5.6
	F	6.8	5.2	12.0
	Total	31.6	65.8	97.4
April 1959	A	5.0	1.6	6.6
	B	1.2	1.6	2.8
	C	3.8	4.0	7.8
	D	1.6	6.2	7.8
	E	1.8	2.2	4.0
	F	0.6	0.6	1.2
	Total	14.0	16.2	30.2
November 1959	A	11.6	4.8	16.4
	B	24.6	17.6	42.2
	C	18.0	7.4	25.4
	D	4.6	34.4	39.0
	E	5.6	27.6	33.2
	F	10.4	2.0	12.4
	Total	74.8	93.8	168.6

TABLE XV (a)—(Contd.)

Year/Month	Treatments	Depth counts average		Total
		0–12″	12–24″	
January 1960	A	13.0	2.8	15.8
	B	10.2	3.0	13.2
	C	7.2	3.2	10.4
	D	10.4	2.8	13.2
	E	20.4	16.6	37.0
	F	10.6	5.6	16.2
	Total	71.8	34.0	105.8
Grand Total		297.8	337.6	635.4

Critical difference: 27.72.

Significance: **Treatments** (No); **Depths** (Yes**); **Months** (Yes**).

Conclusion Depths: **0-12″ 12-24″;**

Months: **April 1959, Feb. 1959, Jan. 1960, Nov. 1959, Dec. 1958.**

Interaction Significance: Month × Depth (No); Treat. × Depth (No); Month × Treat. (No).

** At 1%.

TABLE XV (b)

Effect of Nematicides, Soil Amendments and Farmyard Manure on Nematodes — Predators

(December 1958 — January 1960)

Year/Month	Treatments	Depth counts average		Total
		0–12″	12–24″	
December 1958	A	5.6	2.2	7.8
	B	8.4	3.8	12.2
	C	5.6	3.0	8.6
	D	4.4	0.8	5.2
	E	17.8	4.0	21.8
	F	1.2	2.0	3.2
	Total	43.0	15.8	58.8

TABLE XV(b)—(Contd.)

Year/Month	Treatments	Depth counts average		Total
		0–12″	12–24″	
February 1959	A	1.0	0.8	1.8
	B	11.4	4.6	16.0
	C	1.0	6.0	7.0
	D	0.2	0.8	1.0
	E	2.8	20.8	23.6
	F	1.2	2.2	3.4
	Total	17.6	35.2	52.8
April 1959	A	2.2	1.0	3.2
	B	1.2	0.4	1.6
	C	1.6	1.0	2.6
	D	0.4	0.2	0.6
	E	0.2	0.2	0.4
	F	0.4	1.4	1.8
	Total	6.0	4.2	10.2
November 1959	A	3.2	1.2	4.4
	B	3.6	2.0	5.6
	C	2.4	1.0	3.4
	D	2.8	1.8	4.6
	E	1.2	0.8	2.0
	F	3.4	0.4	3.8
	Total	16.6	7.2	23.8
January 1960	A	0.4	—	0.4
	B	3.0	0.8	3.8
	C	1.6	0.6	2.2
	D	2.0	0.8	2.8
	E	1.2	0.6	1.8
	F	1.0	—	1.0
	Total	9.2	2.8	12.0
Grand Total		92.4	65.2	157.6

Significance: **Treatments** (No); **Depths** (No); **Months** (No).

Interaction significance: Month × Depth (No); Treat. × Depth (No); Month × Treat. (No).

TABLE XVI (a)

Effect of Nematicides, Soil Amendments and Farmyard Manure on Nematodes — Parasites

(March 1960 — March 1961)

Year/Month	Treatments	Depth counts average		Total
		0–12″	12–24″	
March 1960	A	1.2	2.4	3.6
	B	2.8	1.8	4.6
	C	2.6	3.0	5.6
	D	1.0	1.8	2.8
	E	1.0	3.4	4.4
	F	1.2	1.0	2.2
	Total	9.8	13.4	23.2
May 1960	A	2.0	0.2	2.2
	B	0.4	5.4	5.8
	C	4.0	0.6	4.6
	D	5.0	2.2	7.2
	E	0.8	4.2	5.0
	F	1.0	3.6	4.6
	Total	13.2	16.2	29.4
October 1960	A	7.8	4.4	12.2
	B	5.0	5.6	10.6
	C	15.8	18.2	34.0
	D	8.2	3.8	12.0
	E	16.0	6.2	22.2
	F	2.4	3.8	6.2
	Total	55.2	42.0	97.2
January 1961	A	1.8	0.6	2.4
	B	8.4	4.2	12.6
	C	2.6	4.0	6.6
	D	7.2	2.8	10.0
	E	6.6	0.6	7.2
	F	1.2	2.8	4.0
	Total	27.8	15.0	42.8

TABLE XVI (a)—(Contd.)

Year/Month	Treatments	Depth counts average		Total
		0–12″	12–24″	
March 1961	A	—	—	—
	B	0.6	0.2	0.8
	C	0.4	3.2	3.6
	D	—	0.2	0.2
	E	—	0.2	0.2
	F	—	0.2	0.2
	Total	1.0	4.0	5.0
Grand Total		107.0	90.0	197.6

Critical difference: 27.66.

Significance: **Treatments** (No); **Depths** (No); **Months** (Yes**).

Conclusion (Months): **Mar. 1961, Mar. 1960, May 1960, Jan. 1961, Oct. 1960.**

Interaction significance: Month × Depth (No); Treat. × Depth (No); Month × Treat. (No).

** At 1%.

TABLE XVI (b)

Effect of Nematicides, Soil Amendments and Farmyard Manure on Nematodes — Predators

(March 1960 — March 1961)

Year/Month	Treatments	Depth counts average		Total
		0–12″	12–24″	
March 1960	A	—	—	—
	B	—	0.2	0.2
	C	0.4	—	0.4
	D	—	—	—
	E	—	0.6	0.6
	F	0.4	—	0.4
	Total	0.8	0.8	1.6
May 1960	A	0.2	—	0.2
	B	1.0	0.2	1.2
	C	0.2	—	0.2
	D	0.2	0.4	0.6
	E	—	—	—
	F	—	0.6	0.6
	Total	1.6	1.2	2.8

TABLE XVI (b)—(Contd.)

Year/Month	Treatments	Depth counts average		Total
		0–12″	12–24″	
October 1960	A	3.0	3.6	6.6
	B	5.6	1.6	7.2
	C	1.8	2.0	3.8
	D	2.4	1.0	3.4
	E	6.4	1.6	8.0
	F	2.6	1.4	4.0
	Total	21.8	11.2	33.0
January 1961	A	0.4	1.0	1.4
	B	2.4	0.8	3.2
	C	1.0	3.8	4.8
	D	1.0	0.8	1.8
	E	1.0	0.8	1.8
	F	0.8	1.0	1.8
	Total	6.6	8.2	14.8
March 1961	A	0.2	0.8	1.0
	B	1.8	1.4	3.2
	C	1.4	—	1.4
	D	0.4	0.4	0.8
	E	0.4	0.2	0.6
	F	1.0	0.8	1.8
	Total	5.2	3.6	8.8
Grand Total		36.0	25.0	61.0

Critical difference: 3.07.

Significance: **Treatments** (No); **Depths** (No); **Months** (Yes**).

Conclusion (Months): **March 1960, May 1960, March 1961, January 1961, October 1960.**

Interaction significance: Month × Depth (Yes*); Treat. × Depth (No); Month × Treat. (No).

Critical difference: 15.01. Interaction: Month × Depth.

Depth/Month	0–12″	12–24″	Total
March 1960	0.8	0.8	1.6
May 1960	1.6	1.2	2.8
October 1960	21.8	11.2	33.0
January 1961	6.6	8.2	14.8
March 1961	5.2	3.6	8.8
	36.0	25.0	61.0

** At 1%.

* At 5%.

TABLE XVII

Effect of Nematicides and Insecticides on Parasitic Nematodes

Treatments	Corrected mean per cent effectiveness at	
	15 days after treatment	45 days after treatment
A. EN—18133	89.96	92.62
B. Nemagon	93.68	100.00
C. Meta-iso-Systox	—	15.02
D. Ekatin	—	—
E. Malathion	—	—

TABLE XVIII

Head Widths (mm.) of Red Borer Larvae Collected during July 1960 — June 1961

Season	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June
	3.0		3.0			3.2		2.0	2.0	2.5	3.0	
1960-61	2.0		2.0					1.5	1.7	2.3	2.0	
	0.75							1.0	1.0	2.1		
										2.0		
										1.75		
										1.5		
										1.1		
										1.0		

TABLE XIX

Duration of the Larval Stage (From the Date of Collection) and the Pupal Stage of the Red Borer — Z. COFFEAE — in the Laboratory

Larva collected in	H.W. & B.L. at collection (mm.)		H.W. & B.L. at pupation (mm.)		No. of molts	Duration of larval stage	Average Max. temp. (°C.)	Average Min. temp. (°C.)	R.h.
A. February 1960	2.5	22.0	3.5	35.0	4	40	26.6	25.0	59.13
B. April 1960	3.5	37.0	3.5	37.0	1	14	26.8	25.0	71.56
C. October 1960	3.5	38.0	3.9	40.0	4	100	24.2	22.6	72.73
D. November 1960	3.0	27.0	4.0	46.0	3	85	24.8	22.9	65.60
E. March 1961	2.5	22.0	3.0	29.0	3	38	27.2	24.8	68.89

Larva pupated in	Duration of pupal stage			
A. March 1960	35	27.3	22.2	72.49
B. April 1960	17	26.8	25.2	75.34
C. January—February 1961	31	24.7	22.6	66.48
D. February—March 1961	23	27.1	24.5	57.22
E. April 1961	18	26.9	25.2	67.57

H.W. = Head Width; B.L. = Body Length.

TABLE XX

Life History of X. MORSTATTI

Stage	Duration (days)		Average		
	Average	Range	Max. temp. (°C.)	Min. temp. (°C.)	Rel. hum.
Egg	7.6	7— 8	24.6	22.5	63.34
Larva—					
I instar	3.4	3— 4	27.4	25.2	53.58
II instar	4.2	4— 5	27.4	25.6	49.77
III instar	11.25	11—12	23.6	21.9	67.25
Pre-pupa	4.0	—	23.6	21.9	67.25
Pupa	7.0	—	23.7	21.9	61.87
Adult (without food)	10.0	8—13	23.8	22.3	71.99

TABLE XXI

Insects Recorded from Various Coffee Zones

Order	Family	Identity	Host	Locality and date
Coleoptera	Platypodidae	**Crossitarsus** sp., near **pencillatus** Chap.	In **Coffea robusta** stem	C. R. Station, June 1960
	,,	**C. externedentatus** Fairm.	-do-	-do-
,,	Scolytidae	**Xyleborus andrewsi** Bldfd.	-do-	-do-
,,	,,	**Xyleborus** sp.	-do-	-do-
,,	,,	**Xyleborus fornicatus** Eich.	In **Erythrina lithosperma** stem	-do-
,,	Curculionidae	**Astycus** sp. prob. **oculatus** (Heller)	Feeding on **Coffea arabica** and **E. lithosperma**	Saklespur & C. R. Station, May 1961
,,	,,	**Astycus** sp.	-do-	-do-
,,	,,	**Sympiezomias praeteritus** Mshl. or near	-do-	-do-
,,	,,	**Myllocerus 11—pustulatus** Fst.	-do-	-do-
,,	,,	(S.F. Eremninae) Genus?	-do-	-do-
,,	Cerambycidae	**Pothyne moringae** Auriv.	In **E. lithosperma** stem	C. R. Station, March 1961
,,	Tenebrionidae	**Gonocephalum** sp. Chev.	Among mulch	C. R. Station & Saklespur, May-June 1961
Hymenoptera	Encyrtidae	**Cheiloneuromyia javensis** Grlt.	In **Coccus viridis**	C. R. Station, March 1961
,,	Eulophidae	**Coccophagus bogoriensis** Köening.	-do-	-do-
,,	,,	**Coccophagus** sp.	-do-	-do-

TABLE XXI (Contd.)

Order	Family	Identity	Host	Locality and date
Hymenoptera	Braconidae	**Amyosoma** sp.	In **Zeuzera coffeae** larva	C. R. Station, April 1961
		Apanteles spp.	In **Terastia meticulosalis** larva	-do-
,,	Formicidae	**Tetraponera** sp.	On **Xyleborus morstatti** larva	C. R. Station, January 1961
Hem. Homoptera	Cicadellidae	**Nephotettix apicalis** (Mots.)	On **C. arabica** and in trap	C. R. Station, November 1960
,,	,,	**"Tettigonia" ferruginea** (Fab.)	On **C. arabica**	C. R. Station, April 1961
,,	,,	**Gypona** sp.	On **C. arabica** and **C. robusta**	C. R. Station, March-April 61
,,	,,	?	On **C. arabica**	-do-
,,	Coccidae	**Orthezia insignis** Browne	On **C. arabica** and **Coleus** sp.	C. R. Station & Saklespur, May 1961
,,	(S.F. Fulgoroidea)			
,,	Cixiidae	?	On **C. arabica** and **C. robusta**	C. R. Station, March-April 61
,,	Delphacidae	?	In light trap	C. R. Station, September-November 1960
,,	Issidae	?	On **C. arabica**	C. R. Station, March 1961
,,	Flatidae	?	On **C. arabica** and **C. robusta**	-do-
,,	Tropiduchidae	?	On **C. arabica**	-do-
,,	Aphidae	**Toxoptera odinae** (V.d.g.)	On **C. arabica**	Chikmagalur, Saklespur, Coorg, & C. R. Station, September 1960 & March 1961

TABLE XXI (Contd.)

Order	Family	Identity	Host	Locality and date
Hem. Heteroptera	Pentatomidae	Udonga sp.	On **C. arabica** and **E. lithosperma**	C. R. Station, August 1960
Thysanoptera	Thripidae	**Heliothrips haemorrhoidalis** (Bouche)	On **C. arabica** and **C. robusta**	C. R. Station, March 1961
,,	,,	**Thrips** sp.?	-do- and Jasmine	C. R. Station, May 1961
,,	,,	**Thrips** sp. **florum** Schmutz group	On **C. arabica** and **C. robusta**	C. R. Station, March 1961
,,	,,	**Scirtothrips** sp.	-do-	-do-
,,	Phloeothripidae	**Haplothrips** sp.	-do-	-do-
,,	,,	?	On eggs and larvae of **X. morstatti**	C. R. Station, January 1961
,,	,,	?	On **C. arabica** and **C. robusta**	C. R. Station, March 1961
,,	Ecacanthothripidae	**Ecacanthothrips** sp.	-do-	-do-
,,	Aeolothripidae (Franklinothripidae)	**Franklinothrips** sp. (sp. undescribed)	In light trap	C. R. Station, April 1961
Diptera	Drosophilidae	**Gitona perspicax** Knab.	On **Planococcus** sp.	C. R. Station, February 1960

TABLE XXII

Insects Collected from Light Traps at C. R. Station

Order	J-Block April 1, 1960—December 31, 1960	NMS V-Block April 1, 1960—June 30, 1960
Orthoptera	400	117
Dermaptera	121	51
Hem. Homoptera	4,827	2,753
Hem. Heteroptera	512	1,716
Lepidoptera	7,005	1,291
Coleoptera	1,884	5,976
Hymenoptera	5,022	3,471
Diptera	9,516	17,796
Trichoptera	329	501
Isoptera	52	199
Odonata	3	1
Plecoptera	135	3
Neuroptera	4	6
Ephemeroptera	15	81
Psocoptera	71	305
Thysanoptera	—	41
Anoplura	—	—
Collembola	—	122
Mecoptera	—	1
Thysanura	—	1

TABLE XXIII

Distribution of Parasitic Eelworms in Coffee Estates

Estates/L. Dt.	*R.s*	*Ty.* sp.	*Xi.* spp.	*P.c*	*Ro.* sp.	*Hel.* spp.	Other species
1. Karadikhan (nursery), Koppa	—	Yes?	—	—	Yes	Yes	
2. Gungegiri (field), Koppa	—	—	Yes	—	Yes	Yes	
3. Shegode (Nirulla Honda bl.), Koppa	—	—	Yes	—	Yes	—	
4. Murgadhae (new clearings, selections), Koppa	—	—	—	—	—	Yes	
5. Maduba, Koppa	—	—	—	—	—	—	
6. Balur, Mudigere	—	—	—	—	Yes	—	
7. Urvinkhan, Mudigere	—	—	Yes	—	Yes	Yes	
8. Chandragiri (Doobla & Gyardy blocks), Chikmagalur	Parasites present in Doobla block; identity unknown.						
9. Tanneerhalla, N. Coorg	—	—	Yes	—	—	—	
10. Wooligooly, N. Coorg	—	—	—	Yes	Yes	—	Yes[4]
11. Jamboor (K & Q blocks), N. Coorg	Parasites present.						
12. Pollibetta Group (B block), S. Coorg	Parasites present.						
13. Chowdicadoo, S. Coorg	Parasites present.						
14. Elkhill (Oaklands & Ayappankadu blocks), S. Coorg	Parasites present.						
15. Honeyfarm, S. Coorg	—	—	—	—	Yes	—	
16. Lauriston, Nilgiris	Parasites present.						
17. Cottanad, S. Wynaad	—	—	—	—	Yes	Yes	
18. Sekharan, Pulneys	—	—	—	Yes	Yes	Yes[1]	
19. Coffee Research Station, Balehonnur							
(i) M. Block	—	—	Yes	—	Yes	Yes[2]	
(ii) Crawford Area	—	Yes	Yes[3]	—	Yes	Yes	Yes[5]
(iii) NMS I	—	—	Yes	—	Yes	Yes	
(iv) pH cistern	—	—	—	—	Yes	Yes	

TABLE XXIII (Contd.)

1. .**Helicotylenchus** sp. **multicinctus**?
2. **H. nannus & H. erythrinae**
3. **Xiphinema americanum**
4. **Tylenchus** sp.? & **Aphelenchus** sp.
5. **Hoplolaimus** sp.

   Hemicriconemoides sp.

   Aphelenchoides sp.

   Tylencholaimus sp.

R.s.	**Radopholus similis**
Ty. sp.	**Tylenchorhynchus** sp.
Xi. spp.	**Xiphinema** spp.
P.c.	**Pratylenchus coffeae**
Ro. sp.	**Rotylenchulus** sp.
Hel. spp.	**Helicotylenchus spp.**

Total number of samples examined = 1,205.

V. MYCOLOGY

1. Investigations on the various diseases affecting coffee in South India, with regard to the life histories of the causative agencies, ecological factors affecting their incidence, intensity and periodicity, formulation of effective economic disease control measures through fungicidal applications and controlled cultural practices and advisory service through field surveys, on the spot investigations of specific problems, examination of diseased specimens and issue of advisory notes formed the main pre-occupations of the division.

2. The main items of work undertaken during the period were:

I. Studies on Leaf Rust Disease caused by *Hemileia vastatrix*, with particular reference to its control in the field;

II. Studies on Berry Blotch Disease;

III. Studies on Brown-eye-spot Disease caused by *Cercospora* spp.;

IV. Studies on Stem-Wasting—'Kondli' Disease;

V. Studies on Die-back complex; and

VI. Studies on damping off of nursery seedlings caused by *Rhizoctonia solani*.

2.1. Studies on Leaf rust disease caused by Hemileia vastatrix B & Br.:

Disease control through fungicidal sprays :

(a) *Comparison of Proprietary fungicides with Bordeaux mixture:*

(1) *Field Trials at Coffee Research Station, Balehonnur:*

Trial 1:

The trial comparing two concentrations of an eradicant fungicide 0-3818-b, with standard 0.5% Bordeaux mixture, started during 1959 was continued. Observations on leaf retention recorded in the different treatments, from start of trial are furnished in Table 'MY' I.

Out of four observations on leaf retention recorded since start of trial, no significant treatment differences are noticed except in 1961 February observation where Bordeaux treatment is superior to unsprayed control and the lower concentration of 0-3818-b. Even in cases where no statistical significances are noticed, numerically, Bordeaux sprayed plots gave better leaf retention than the other treatments. Further, it was also observed that bushes sprayed with the eradicant fungicide showed phytotoxic symptoms—necrosis of leaves followed by defoliation and die-back of tertiary branches. The trial is being discontinued from the pre-monsoon of 1961.

Trial 2:

This field trial started during March 1960 to study the effect of alternating eradicant and protectant fungicidal applications in controlling leaf disease was con-

tinued. Observation on comparative leaf retention recorded in the different treatments during February 1961 are summarised in the following table:—

Treatments		Mean average E.F.L.S. February 1961
A — Bordeaux 0.5%	4 sprays—1 pre-, 2 post-monsoon and 1 pre-blossom	25.50
B — Flit 407 0.4%	4 sprays—1 pre-, 2 post-monsoon and 1 pre-blossom	31.83
C — Cyprex 65-W 0.3%	4 sprays—1 pre-, 2 post-monsoon and 1 pre-blossom	27.67
D — 0-3818-b—0.35%	4 sprays—1 pre-, 2 post-monsoon and 1 pre-blossom	27.67
E — Flit & Bordeaux combination	4 sprays—pre-blossom with Flit, 1 pre-monsoon and 2 post-monsoon with Bordeaux	25.42
F — Cyprex & Bordeaux combination	4 sprays—timings as above	25.75
G — 0-3818-b & Bordeaux combination	4 sprays—timings as above	27.25
H — Control—Bordeaux	2 sprays—1 pre- and 1 post-monsoon	25.58
I — Bordeaux & Flit combination	3 sprays—pre-monsoon with Bordeaux Sept.-Oct. with Bordeaux Dec.-Jan. with Flit	30.42
J — Bordeaux & Cyprex combination	3 sprays—timings as above	20.67
K — Bordeaux & 0-3818-b combination	3 sprays—timings as above	21.00
L — Bordeaux	3 sprays—timings as above	33.92
M — Bordeaux	3 sprays—1 pre-monsoon and 2 post-monsoon	26.92

Treatments with Cyprex 65-W and 0-3818-b either alone or in combination with Bordeaux have given comparatively poor leaf retention. Treatment L—3 sprays of Bordeaux incorporating a spray round in December-January has given the highest leaf retention. Combinations of Bordeaux and Flit-407 as well as Flit-407 also—3 and 4 rounds spray have given appreciably good leaf retention. The trial is being continued.

Trial 3:

In order to find the efficacy of oil copper sprays as compared with standard 0.5% Bordeaux in controlling leaf disease, a row trial has been started during this pre-monsoon period. The details of the trial are furnished below:—

Locality: C. R. Station, Balehonnur.

Started in: May 1961.

Layout: Randomized, replicated 4 times.

Plot size: Single row of 8 plants with unsprayed common guard rows between treatments.

Treatments: 6.

A — Oil copper formulation at 7½ lbs. copper/acre—200 glns./acre.

B — -do- 5 „ -do-

C — -do- 2½ „ -do-

D — 1% Bordeaux mixture „

E — 0.5% Bordeaux mixture „

F — Unsprayed control.

The pre-monsoon spray applications were completed during May 1961 and initial observations on leaf retention also recorded. Further results are awaited.

(2) *Field Trials at Coffee Research Sub-Station, Chethalli:*

Trial 4:

The trial started during May 1957 using Flit-406, Kirti copper and Bordeaux mixture with and without addition of sticker was continued till 1960 post-monsoon period. Observations on leaf retention in the different treatments recorded since start of trial are summarised in Table 'MY' II.

No significant treatment differences are noticed in September 1960 leaf counts. Reviewing the results from start of trial, it is noticed that no significant treatment differences are noticed except in September 1957, where Bordeaux treatment was superior to all other treatments. The trial is concluded and discontinued.

Trial 5:

The trial comparing Cobredon, Cupricol, Parry cop and Dithane M-22 with Bordeaux with and without addition of sticker started during 1958 pre-monsoon was continued. Observations recorded during September 1960 and February 1961 are summarised in Table 'MY' III.

No statistically significant differences in leaf retention are noticed between treatments in both the observations, however, Bordeaux sprayed plots showed numerically better leaf retention than the other treatments.

Trial 6:

This pre-monsoon season another field trial was started comparing standard proprietary copper fungicides with Bordeaux with regard to efficacy of leaf disease control. The details of the trial are furnished below:—

Locality: C.R.S.S., Chethalli.

Started in: May 1961.

Layout: Row trial.

Plot size: Single row of 5 plants with common guard rows between treatments.

Treatments: 11.

A — Unsprayed control.

B — Bordeaux—0.5%.

C — Copper oxychloride—1 lb. in 40 gals. water.

D — Cuprous oxide -do-

E — Colloidal copper -do-

F — Bordeaux—1%.

G — Copper oxychloride—2 lbs. in 40 gols. water.

H — Cuprous oxide -do-

I — Colloidal copper -do-

J — Blitane—1 lb. in 40gals. water.

K — „ 2 lbs. in 40 gals. water.

The pre-monsoon spray application with the different formulations and the initial leaf counts have been completed and further results are awaited.

(3) *Field trials in different coffee zones under Proprietary Products Testing Scheme:*

Trial 7:

The trial started at Woodlands Estate, Coonoor, during 1958 post-monsoon, comparing Cupricol, Kirti copper and Microcop with Bordeaux mixture was continued. Observations on leaf retention and yields recorded during the year are furnished in Table 'MY' IV.

Though no statistically significant treatment differences are observed in both the 1960 September leaf counts and 1960-61 crops, it is however noticed that numerically, Bordeaux sprayed plots gave better results than the plots sprayed with the proprietary formulations. The trial is being continued.

Trial 8:

This trial started at Pillavali Estate, Pulneys, during 1958 post-monsoon period, comparing Cobredon and Colloidal copper with Bordeaux was continued. Observations on leaf retention and crop yields are summarised in Table 'MY' V.

No significant differences in both leaf retention and crop yields are noticed between Bordeaux and the proprietary fungicides treated plots.

Trial 9:

This comparative field trial using Flit-406, Parry cop and Bordeaux started at Bonaventura Estate, Shevaroys, during 1958 post-monsoon was continued. The results of observations are furnished in Table 'MY' VI.

No significant treatment differences are observed; however, Bordeaux treated plots gave better leaf retention and crop yield than the proprietary fungicides treated plots, numerically.

Trial 10:

The trial at Coffee Research Sub-Station, Chethalli, started during September 1958, comparing Colloidal copper, Microcop and Ultra Sulphur with Bordeaux mixture was continued. Treatment applications were given as scheduled and observations recorded during the year are furnished in Table 'MY' VII.

No significant differences are noticed in both leaf counts as well as crop yields, between Bordeaux and the proprietary fungicidal treatments.

Trial 11:

This trial started at Cheekanahally Estate, Saklespur, during 1959 pre-monsoon period comparing Flit-406 and Cupricol with Bordeaux was continued. The results of observations are summarised in Table 'MY' VIII.

Treatment differences with regard to leaf retention during September 1960 and crop yields of 1960-61 are statistically not significant; however, numerically, plain Bordeaux and Bordeaux with sticker gave better results than the proprietary formulations with regard to leaf retention and crop yields.

Trial 12:

The trial started at Vasanthcool Estate, Chikmagalur, during 1959 pre-monsoon, comparing Parry cop, Cobredon and Kirti copper with Bordeaux was continued. Applications of the treatments and recording of observations were carried out as scheduled. Results of observations are furnished in Table 'MY' IX.

No significant treatment differences are observed in September 1960 and February 1961 leaf counts and 1960-61 crop yields.

General conclusions on field trials comparing proprietary fungicides with standard Bordeaux mixture for leaf disease control:

The relative efficacy of twelve different proprietary formulations (fungicides and stickers) with regard to leaf rust disease control has been compared with that of standard 0.5% Bordeaux mixture. In most of these trials, treatment difference with regard to leaf retention and crop yields were found to be not significant. In the majority of cases, however, the trend was towards better numerical results in the case of Bordeaux treatment as compared to the proprietary fungicides treatments. Similar results were indicated in previous year's data also.

(b) *Spraying of leaf disease resistant selections:*

The field trials started during 1959 pre-monsoon period to find out the possible beneficial effects to be derived through spraying leaf disease resistant selections, were continued.

Trial 1:

Bulk Observational Trial at Kerkkikonda Estate, Balehonnur: The applications of the different treatments were carried out as scheduled and the yield data recorded in the different treatments during 1959-60 and 1960-61 are furnished in Table 'MY' X.

It is seen from 1960-61 yield data that in both S. 288 and S. 333, treatment D, *i.e.*, top spray with 2% Bordeaux has given the highest yield, followed by treatment A, *i.e.*, normal under surface spray with 0.5% Bordeaux, unsprayed control treatment giving the poorest yields.

Trial 2:

Critical Trial at Coffee Research Sub-Station, Chethalli: Observations on comparative leaf retention, growth rates and crop yields are summarised in Table 'MY' XI.

No significant differences are noticed between unsprayed and sprayed blocks with regard to leaf retention, rate of growth and crop yields. The trial is being continued.

(c) *Spraying upper surface of leaves vs. normal under surface spraying for leaf rust disease control:*

This trial started during 1959 pre-monsoon at C.R.S., Balehonnur, was continued. Observations recorded are summarised in Table 'MY' XII.

From the results it is observed that in September 1960 leaf counts and 1960-61 crop yields, no significant treatment differences were noticed. In February 1961 leaf counts, however, treatment E, *i.e.*, upper surface spray with 2% Bordeaux gave significantly better leaf retention over other treatments, unsprayed control giving the least leaf retention.

The block in which this trial is being conducted has a mixed plant population of leaf disease resistant selections and susceptible Kents, the former having come in as supplies. Since this factor may jeopardise the results of the trial, the same trial is being repeated in another block with a pure stand of leaf disease susceptible coffee from 1961 pre-monsoon onwards.

(d) *Frequency and timing of spray:*

This trial started during 1960 pre-monsoon period incorporating different spray rounds at different periods in order to study the efficacy, utility and economics of increased rounds of spray for effective control of leaf disease was continued. Observations on comparative leaf retention and crop yields recorded in the different treatments are furnished in Table 'MY' XIII.

It is seen from the results that differences in leaf retention during February 1961 between the various treatments are not significant; however, numerically, treatments

D and G where a pre-blossom round of spray was incorporated in the schedule, have given better leaf retention than the rest of the treatments. The crop yields recorded being the basic one, no statistical interpretations are made. The trial is being continued.

(e) *Comparison of types of Bordeaux mixture and methods of mixing ingredients with regard to leaf rust disease control:*

Object: To find out whether types of Bordeaux, *viz.*, acid, neutral and alkaline mixtures, prepared by different methods of mixing ingredients exert any influence on degree of control of leaf rust disease, a row trial was started during 1961 pre-monsoon period.

The details of the trial are furnished below:

Locality: C.R.S., Balehonnur.

Started in: June 1961.

Layout: Row trial, randomized, replicated three times.

Plot size: Single row of 7 plants with common guard rows between treatments.

Treatments: 3—

A — Acidic Bordeaux—0.5% — pH 6 to 6.4

B — Neutral „ —0.5% — pH 6.8 to 7.2

C — Alkaline „ —0.5% — pH 8.8 to 9.2

Sub-treatments:

(1) Pouring concentrated Copper Sulphate solution to dilute lime suspension.

(2) Pouring concentrated lime suspension to dilute Copper Sulphate solution.

(3) Pouring dilute Copper Sulphate solution to concentrated lime suspension.

The application of the different treatments have been carried out during June 1961. Initial leaf counts were also recorded.

2.2. Studies on Berry Blotch Disease:

The main indications from the studies conducted during 1959-60 season on this new malady affecting the coffee berries were:

(1) a *Cercospora* sp. appears to be involved in causing this disease;

(2) the presence of blotched berries affects the quality of the crop;

(3) disease incidence is comparatively more in open exposed conditions than in shaded conditions;

(4) age of the plant did not affect appreciably the intensity of berry blotch incidence;

(5) plants sprayed with fungicides during pre and post-monsoon periods showed comparatively lesser disease incidence than unsprayed plants; and

(6) sprays with different concentrations of Bordeaux effected better disease control than Flit-406.

To determine the comparative efficacy of different fungicidal formulations and their timings of application for effective economic control of the disease, further extended trials were started during 1960-61 season. The details of these trials and the observations on the disease incidence recorded during November—December 1960 are furnished below.

Trial 1:

Comparison of different strengths of Bordeaux and Flit-406 with regard to efficacy of control of berry blotch: The details of the treatments imposed and observations recorded are summarised in the following table:

Treatments	Mean percentage disease incidence	General mean	Standard error mean	Critical difference	Significance	Conclusions
A — Bordeaux 0.5%	10.74					
B — ,, 1%	17.32	15.58	1.73	5.17	Yes	C B A D E
C — ,, 2%	5.86			at p-		
D — Flit-406 0.4%	19.22					
E — Unsprayed control	34.76					

It is seen from above results that all sprayed treatments show less disease incidence compared to unsprayed control. Sprays with different concentrations of Bordeaux, controlled berry blotch more effectively than Flit-406. Between the three concentrations of Bordeaux tried, though there were no significant differences, numerically, the highest concentration of Bordeaux, *viz.*, 2%, effected maximum disease control. Similar trends were noticed in previous year's trials also.

Trial 2:

Comparison of different fungicides for control of berry blotch: The details of the treatments imposed and observations on disease incidence recorded are summarised in the following table:

Treatments	Mean percentage disease incidence
A_1 — Bordeaux — 1%	20.98
A_2 — – do – — 1%	16.00
B_1 — Colloidal copper — 11 lb. in 40 glns. water	22.56
B_2 — – do – – do –	20.00
C_1 — Flit – 406 — 0.4%	33.88
C_2 — – do – 0.4%	29.64
D_1 — Ultra Sulphur — 1 lb. in 40 glns .water	42.50
D_2 — – do – – do –	41.50
E — Unsprayed control	73.12

Sub-treatments:

(1) Single spray application during July break.

(2) Two sprays, first prior to commencement of S. W. Monsoon and the second at close of S. W. Monsoon (June & September).

From the above results, it is noticed that all the sprayed treatments show lesser disease incidence compared to unsprayed control. The copper fungicides are more effective than Flit-406 and Ultra Sulphur in disease control. Between the double and single spray applications, the former effected better disease control than the latter in all the fungicides. Bordeaux 1% sprayed twice during the year effected maximum disease control.

Trial 3:

Time of spray for control of berry blotch: To find out the critical periods at which fungicidal sprays effected maximum disease control, the following trial was conducted. The details of the treatments imposed and observations recorded are summarised in the following table:

Treatments	Mean percentage of disease incidence
A_1 — Bordeaux spray during July break — 1 spray	25.94
A_2 — – do – ,, — ,,	25.84
B_1 — – do – August end — ,,	36.78
B_2 — – do – ,, — ,,	34.14
C_1 — – do – mid Septr. — ,,	64.50
C_2 — – do – ,, — ,,	59.62

Treatments	Mean percentage of disease incidence
D_1 — Bordeaux spray during early Octr. — 1 spray	66.10
D_2 — –do– ,, — ,,	57.76
E_1 — –do– June & Septr. — 2 sprays	32.72
E_2 — –do– ,, — ,,	26.12
F_1 — –do– July & Octr. — ,,	34.74
F_2 — –do– ,, — ,,	25.32
G_1 — –do– August & Octr. — ,,	41.98
G_2 — –do– ,, — ,,	48.30
H — Unsprayed control	73.12

Sub-treatments:

(1) Spray with 0.5% Bordeaux.

(2) Spray with 1% Bordeaux.

It is seen from the above results that—

(a) All the spray treatments showed less disease incidence compared to unsprayed control.

(b) Treatment F_2, *i.e.*, two sprays during July & October with 1% Bordeaux effected maximum disease control, followed by treatment A_2; *i.e.*, single spray with 1% Bordeaux during July.

(c) June-July appears to be the critical period for effective spray probably coinciding with disease initiation and spread. This is borne out from the fact that single or double sprays during June and July months showed minimum disease incidence.

(d) Spray applied later than August has not effected much disease control.

The time of spray trial is being repeated during 1961-62 season with slightly modified timings. Further, attempts at reproduction of the disease through artificial inoculations employing cultures and natural material of *Cercospora* sp. involved in berry blotch are in progress. Observations so far have not shown any disease incidence. The observations are to be continued.

2.3. Studies on Brown-eye-spot Disease caused by Cercospora spp.:

Disease control through fungicidal sprays:

Earlier trials, using different fungicidal formulations showed that spray applications with 1% Bordeaux, 0.4% Flit-406 and 0.4% Dithane M-22 at fortnightly to monthly intervals from April-May to October-November controlled the disease.

This season a nursery trial is in progress employing varying spray schedules with the object of finding out the critical periods at which fungicidal sprays gave maximum efficacy. The details of the trial are furnished below:

Locality: C.R.S., Balehonnur; *Started in:* April 1961;

Layout: Randomised, replicated 4 times;

Plot size: 6 seedlings per sub-treatment of each replication;

Treatments:

A — Dithane M–22 — 0.4%
B — Flit–406 — 0.4%
C — Bordeaux — 1%
D — —do— — 0.5%
E — Ferbam — 0.5%
F — Flit–407 — 0.4%
G — Unsprayed control;

Sub-treatments:

(1) Sprays during late May, early June, mid September, mid October and mid November	5	rounds of spray
(2) Sprays during late May, early June, early October and early November	4	-do-
(3) Sprays during early June, early October and early November	3	-do-
(4) Sprays during early June and late October	2	-do-
(5) Sprays during late May, early June, early October, mid October, early November and mid November	6	-do-
(6) Early June, early October, mid October, early November and mid November	5	-do-
(7) Early June, mid October and early November	3	-do-

At start of the trial during April-May, all the seedlings were practically free from disease incidence. The percentage or disease incidence in the different treatments have been recorded during July 1961. As the different treatments complete the schedule of sprays with the fungicides only by November, further observations on disease incidence during October-November are awaited for interpretation of data.

2.4. Studies on Stem-Wasting—'Kondli' Disease of Seedlings:

Investigations carried out during 1958 and 1959 seasons indicated that high incidence of Kondli was invariably associated with frequent and liberal applications of Bordeaux mixture to nursery seedlings. To confirm these findings and to probe further into the causes of this malady, to determine the various factors influencing its incidence and intensity and to find out an effective control measure, detailed studies were taken up during 1960. At the time of writing the Annual Report for 1959-60 season, *i.e.*, till end of July 1960, no incidence of Kondli was seen in most of these trials, but subsequently in the following months, Kondli disease incidence was observed. The details of these trials and the observations recorded are furnished below.

A. Investigations on the nature of the malady:

(a) *Examination of affected tissues:*

As reported earlier, the following micro-organism, *viz.*, *Chaetophoma* Sp., *Fusarium* Sp., *Phoma* Sp., and a bacterial culture were occasionally isolated from the malformed tissues of Kondli affected seedlings.

(b) *Kondli—a parasitic or non-parasitic disease?*

To find out whether Kondli is caused by a parasitic agency and if so at what stage, *i.e.*, before or after transplanting seedlings from germination beds the organism gains an entry into the seedling, the following trial was conducted:

Treatments:

A — Seed bed sterilized — Basket soil sterilized (with 0.8% Formaldehyde)

B — —do— — ,, not sterilized —do—

C — ,, not sterilized — ,, sterilized —do—

D — ,, —do— — ,, not sterilized

Sub-treatments:

(1) Seedlings drenched with 1% Flit-406 -do-

(2) -do- 0.4% Bordeaux at monthly intervals;

(3) Untreated control.

Observations on the incidence of Kondli recorded during September 1960, when maximum incidence was noticed are summarised in the following table:

Treatments	Percentage of Kondli incidence recorded during Septr. 1960		
	Seedlings sprayed with Bordeaux	Seedlings sprayed with Flit-406	Unsprayed control seedlings
A	46.70	nil	nil
B	26.80	"	"
C	46.70	"	"
D	60.00	"	"

It is noticed from the above results that seedlings receiving Bordeaux spray at monthly intervals showed Kondli incidence to varying intensities, whereas seedlings sprayed with Flit-406 and unsprayed control seedlings did not develop any Kondli symptoms irrespective of the treatment applied, *viz.*, Seed bed and/or bbasket soil being sterile or non-sterile. Since disease incidence is noticed in seedlings growing in sterile or non-sterile soil only wherever Bordeaux is applied, the possibility of an infective pathogen appears remote.

(c) *Studies on the virus aspect of Kondli disease:*

Graft transmission studies:

The possibility of graft transmissibility of Kondli was explored through reciprocal grafting of healthy and diseased seedlings.

Diseased stock × healthy scion

Healthy stock × diseased scion

Grafts were done at different nodes of the stock during August 1960 as soon as natural incidence of Kondli was observed. Successful unions were established in some of the grafts. In none of these, indications of transmission of the disease symptoms were noticed.

Sap inoculations:

Plant sap extracted from Kondli affected seedlings were used for inoculating healthy seedlings carried out during August 1960. Continued observations showed that no transmission of the disease symptoms occurred in any of the inoculated seedlings.

From the above two trials, it would appear that Kondli is probably not caused by a virus agent.

B. Artificial inoculations to induce Kondli:

To find out whether the symptoms of the malady could be reproduced artificially on healthy seedlings, inoculations with different micro-organisms found associated with malformed tissues of Kondli affected seedlings were carried out. The details of these trials are furnished below:

Trial 1:

In this trial, the soil in the baskets were inoculated with cultures of *Phoma* sp., *Fusarium* sp., bacterial culture as well as surface scrapings of Kondli affected seedlings, before sowing seeds in the soil. Initial sterilization of the soil used for filling the baskets and non-sterilization of the same formed two sub-treatments. Half the number of seedlings in each sub-treatment received spray with 1% Bordeaux at monthly intervals, the other half being unsprayed. Observations on incidence of Kondli recorded in the different treatments and sub-treatments during September 1960 are summarised in the following table:

Treatments	Percentage of Kondli incidence recorded during September 1960			
	Seedlings growing in sterile soil		Seedlings growing in non-sterile soil	
	Bordeaux Sprayed	Unsprayed	Bordeaux Sprayed	Unsprayed
Uninoculated control	62.50	nil	18.20	nil
Inoculated with *Phoma* sp.	16.60	,,	27.20	,,
Inoculated with *Fusarium* sp.	27.20	,,	27.20	,,
Inoculated with Bacterial culture	22.20	,,	33.30	,,
Inoculated with scraping from Kondli affected seedling	50.00	,,	25.00	,,

From the above results it is noticed that:—

(1) there is no direct influence of the treatment, *i.e.*, inoculated with different organisms or not inoculated at all, or sub-treatment, *i.e.*, seedlings growing in sterile or non-sterile soil on Kondli incidence.

(2) irrespective of the treatment and sub-treatments, Kondli incidence was noticed in seedlings receiving Bordeaux spray at monthly intervals, no Kondli being noticed in unsprayed seedlings.

Trial 2:

Artificial inoculations were carried on healthy seedlings at monthly intervals from March to August 1960 using *Chaetophoma* sp., *Phoma* sp., *Fusarium* sp., Bacterial culture and surface scraping from Kondli affected seedlings as compared with an uninoculated control. As sub-treatments, half the seedlings under each treatment were sprayed with Bordeaux at monthly intervals (the first spray being 5 days after inoculation), the other seedlings being unsprayed. All the seedlings were grown in soil sterilized with 0.8% Formaldehyde initially. Observations on Kondli incidence recorded are summarised in the following table:

Period of inoculation	Percentage of Kondli incidence in the different treatments and sub-treatments											
	Chaetophoma sp.		Phoma sp.		Fusarium sp.		Bacteria		Affected tissue scraping		Uninoculated control	
	Bordeaux spray	No spray	Bordeaux spray	No spray	Bordeaux spray	No spray	Bordeaux spray	No spray	Bordeaux spray	No spray	Bordeaux spray	No spray
March (received 6 sprays)	76.40	nil	70.50	nil	76.40	nil	72.20	nil	83.30	nil	88.90	nil
April (,, 5 ,,)	44.90	,,	27.70	,,	22.70	,,	50.00	,,	61.00	,,	50.00	,,
May (,, 4 ,,)	94.50	,,	77.80	,,	88.90	,,	82.30	,,	94.50	,,	88.90	,,
June (,, 3 ,,)	33.30	,,	38.90	,,	50.00	,,	77.80	,,	58.80	,,	64.70	,,
July (,, 2 ,,)	nil	,,	nil	,,	nil	,,	nil	,,	nil	,,	nil	,,
August (,, 1 ,,)	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,

From the above results it is noticed that:—

(1) In the series of inoculations carried out with different organisms during the period March to June, the seedlings under the sub-treatment receiving Bordeaux spray at monthly intervals, Kondli incidence to varying intensities is noticed whereas in the seedlings receiving no spray, no Kondli is noticed. The above remarks hold good for the uninoculated control treatment also.

(2) In the July and August series of inoculations, no Kondli incidence is noticed even in seedlings receiving the Bordeaux spray—probably because these series receive only 2 and 1 application of Bordeaux respectively as against 6, 5, 4 and 3 applications in the March to June series.

Trial 3:

With a view to find out whether incidence of leaf and stem infections on tender seedlings by *Myrothecium advena* may later lead on to Kondli symptoms, healthy seedlings were inoculated at cotyledonary and 1 pair leaf stages. An uninoculated control set was also maintained. The details of the trial are furnished below:

Treatments:

A — Seedlings inoculated with *Myrothecium advena* at cotyledonary leaf stage —arrest development of lesion by Bordeaux application.

B — Seedlings inoculated as above—instead of Bordeaux, Flit-406 applied.

C — Seedlings inoculated as above—no fungicide applied.

D — Seedlings inoculated as above at 1 pair of leaf stage—apply Bordeaux.

E — Uninoculated control.

Sub-treatments:

(1) Bordeaux spray at monthly intervals.

(2) No spray applications.

In treatments A, B, and C inoculations were done during late April 1960 and in D during late May. Successful infections resulted and most of the seedlings which did not receive monthly applications of fungicide died by July, whereas in the sprayed series lesser number of the infected seedlings were observed. Observations on incidence of Kondli showed that from August onwards symptoms were noticed in some of the seedlings. The incidence of Kondli recorded during September 1960 when maximum incidence was recorded is furnished in the following table. The incidence of infection by *Myrothecium advena* is also furnished in the table.

Treatments	Percentage incidence of Myrothecium and Kondli in the sub-treatments			
	Seedlings sprayed with Bordeaux at monthly intervals		Seedlings not receiving spray	
	%age incidence of Myrothecium	%age incidence of Kondli	%age incidence of Myrothecium	%age incidence of Kondli
A	25.00	84.10	45.80	nil
B	16.60	89.40	12.50	,,
C	37.50	64.60	75.00	,,
D	33.30	68.40	45.80	,,
E	nil	66.70	nil	,,

The above results indicate that—

(1) artificial infections were successful when inoculated with *Myrothecium advena.*

(2) Application of Bordeaux or Flit-406 following inoculation reduced the percentage of successful infections to a certain extent. Subsequent sprays with Bordeaux at monthly intervals have also helped in keeping disease incidence under check.

(3) No correlation between infection by Myrothecium at an early stage of the seedlings and later incidence of Kondli is noticed as Kondli incidence to varying degrees is noticed in all the treatment including uninoculated control, wherever monthly applications of Bordeaux have been made; however, no Kondli is seen in the seedlings not receiving Bordeaux whether inoculated with Myrothecium or not.

(4) Results of the above trial indicate that Kondli is not possibly the result of infection by a parasitic agency.

C. Studies on influence of application of fertilizers on Kondli incidence:

Trial 1:

To find out whether the type of nutrition provided has any influence on Kondli incidence, application of different fertilizers to healthy seedlings was tried. The different fertilizers were applied at fortnightly intervals, an unfertilized plot being maintained as control. In each treatment, half the number of seedlings were sprayed with 1% Bordeaux at monthly intervals, the other seedlings being unsprayed. Observations on Kondli incidence are summarised in following table:

Treatments	Percentage of Kondli incidence resulted during September 1960	
	Seedlings sprayed with Bordeaux	Seedlings not sprayed
Urea—a pinch per seedling	17.80	nil
Sterameal—a pinch per seedling	56.70	,,
Cowdung slurry—drenching	56.30	,,
Lime—a pinch per seedling	56.70	,,
N.P.K.—(12:7:12) per seedling	20.00	,,
Unfertilized control	53.30	,,

It is seen from the above that Kondli incidence to varying degrees is noticed in seedlings receiving monthly spray with Bordeaux irrespective of fertilized or unfertilized and the type of fertilizer applied; whereas no Kondli is noticed in unsprayed seedlings whether fertilized or not. These results confirm the earlier findings that the type of nutrition has no direct influence on Kondli incidence.

Trial 2:

To find out the possibility of application of Urea to tender nursery seedlings scorching the stem tissues at the collar level and later leading on to Kondli symptoms, a trial was conducted wherein different methods of application of Urea were employed. Half the number of seedlings received Bordeaux spray at monthly intervals, the other half number being unsprayed. The details of the trial are furnished below:

Treatments:

A — Urea in solid form—applied to soil touching the collar region.

B — Urea in solid form—applied to soil far-away from collar region.

C — Urea in liquid form—applied as a soil drench.

D — Unfertilized control.

Sub-treatments:

(1) Bordeaux applied at monthly intervals.

(2) No Bordeaux applied.

Observations on incidence of Kondli recorded are summarised in the following table:

Treatments	Percentage incidence of Kondli recorded during September 1960	
	Seedlings sprayed with Bordeaux	Seedlings not sprayed
A	42.80	nil
B	27.80	,,
C	6.20	,,
D	11.80	,,

Though varying intensities of incidence of Kondli is noticed in the different methods of applying Urea where the seedlings received monthly spray of Bordeaux, since no Kondli is noticed in the unsprayed seedlings it is to be presumed that the method of application of Urea has exerted no direct influence on Kondli incidence.

From the above, it would appear that there is no direct influence of the type of nutrition provided or the method of its application on incidence of Kondli.

D. Studies on influence of application of Bordeaux mixture on incidence of Kondli:

Since a positive correlation between frequent application of Bordeaux mixture and incidence of Kondli was observed in the previous years trials, detailed studies on the influence of period and frequency of application, as well as volume of Bordeaux applied to nursery seedlings on incidence of Kondli were conducted. The details of these trials and observations recorded are furnished below:

Trial 1:

Influence of frequency of Bordeaux application on Kondli incidence:

Treatments:

A — 6	sprays with 1% Bordeaux at monthly intervals starting from	March 1960
B — 5	—do—	April 1960
C — 4	—do—	May 1960
D — 3	—do—	June 1960
E — 2	—do—	July 1960
F — 1	—do—	Aug. 1960
G — Unsprayed control.		

Observations on incidence of Kondli recorded during September 1960 are summarised in the following table:

Treatments	Percentage incidence of Kondli recorded during September 1960
A — 6 sprays	63.30
B — 5 „	90.00
C — 4 „	82.80
D — 3 „	75.80
E — 2 „	43.30
F — 1 spray	nil
G — Unsprayed control	nil

It is noticed from the above results that Kondli incidence is heavy in 6, 5, 4 and 3 spray treatments, comparatively less in 2 spray treatments and 'Nil' in single and no spray treatments.

Trial 2:

Influence of period of application of Bordeaux on Kondli incidence:

The details of the trial and observations on Kondli incidence are recorded in the following table:

Treatments	Percentage incidence of Kondli recorded in the sub-treatments		
	3 Bordeaux sprays at 10 days interval	2 Bordeaux sprays at 15 days interval	1 Bordeaux spray
Bordeaux spray during March	nil	nil	nil
-do- April	nil	nil	nil
-do- May	38.80	22.20	nil
-do- June	55.50	11.10	5.50
-do- July	58.80	38.80	5.50
-do- August	nil	nil	nil
Unsprayed control	nil	nil	nil

It is noticed from the above results that spray applications with Bordeaux during May-June and July periods corresponds with incidence of Kondli, whereas treatments with spray applications in March, April and August as well as unsprayed control treatment do not show any incidence of Kondli. Further, a higher percentage incidence of

Kondli is noticed during May-June-July period in cases where Bordeaux is applied at frequent intervals. This would indicate that there is a positive correlation between Bordeaux spray during May-June-July period and a high incidence of Kondli.

Trial 3:

Influence of period and frequency of Bordeaux application on Kondli incidence:

The details of the treatments imposed and the observations recorded are summarised in the following table:

Treatments	Percentage disease incidence recorded during Septr. 1960
Monthly Bordeaux spray in March–April–May—3 sprays	nil
—do— June–July–August—3 sprays	72.00
Single spray in April—1 spray	nil
—do— July—1 spray	27.60
Unsprayed control	nil

While no incidence of Kondli is noticed in unsprayed control, three spray treatment during March-April-May and single spray treatment in April, in the three spray treatment during June-July-August and single spray treatment in July, Kondli incidence is noticed. It is thus noticed that frequent Bordeaux sprays during June-July-August period corresponds to heavy incidence of Kondli.

Trial 4:

Influence of volume of Bordeaux applied to incidence of Kondli:

To find out whether there is any correlation between the volumes of Bordeaux mixture applied to nursery seedlings and the incidence of Kondli and the intensity, healthy seedlings were subjected to different treatments wherein monthly spray applications of different volumes of Bordeaux were taken up. The details of the treatments and observations recorded are furnished in following table:

Treatments	Percentage incidence of Kondli recorded during September 1960
Monthly Bordeaux spray at 6 pints per 30 seedlings	73.30
-do- 4 -do- -do-	40.00
-do- 2 -do- -do-	30.00
-do- 1 -do- -do-	27.50
-do- ½ -do- -do-	23.30
Unsprayed control	nil

Disease incidence to varying degrees is noticed in plots receiving monthly Bordeaux spray at different volumes and not in unsprayed control. Further, disease incidence is noticed to be highest in plots receiving highest volume of Bordeaux spray, disease incidence falling down with reduction in the volume of Bordeaux used for spray.

Results from the above trials clearly indicate that:—

(1) Kondli incidence is correlated with frequent Bordeaux application to nursery seedlings.

(2) Applications of Bordeaux to nursery seedlings during June-July period appear to correspond with a high incidence of Kondli.

(3) Applications of Bordeaux ranging from 6 to 3 have shown high incidence of Kondli whereas 2 or less rounds applied has often shown negligible or nil incidence of Kondli.

(4) The higher the volume of Bordeaux applied to nursery seedlings, the greater the percentage and intensity of Kondli noticed.

E. Influence of spraying different chemicals on incidence of Kondli:

In order to find out the influence of spraying the nursery seedlings with different chemicals on the incidence of Kondli, the following trials were conducted:

Trial 1:

Earlier trials had indicated a correlation between incidence of Kondli and frequent application of Bordeaux on nursery seedlings. To find out whether the same influence on Kondli incidence could be obtained with other copper fungicidal sprays, a trial was started during March 1960. Different copper containing fungicidal formulations were used for spraying nursery seedlings at monthly intervals. The details of the treatments and observations recorded are furnished in the following table:

Treatments		%age incidence of Kondli recorded during Sept. 1960
Monthly spray with Bordeaux 1%		50.00
-do-	Cheshunt's compound	6.90
-do-	Copper Oxychloride 1 lb. in 40 gals. water	13.30
-do-	Colloidal copper 1 lb. in 40 gals.	13.30
Untreated control		nil

While no incidence of Kondli was observed in unsprayed control seedlings, disease incidence to varying degrees was noticed in all the seedlings receiving spray with the different copper fungicides, the highest being in Bordeaux mixture.

Trial 2:

In this trial, healthy seedlings were sprayed with different chemicals, *viz.*, copper fungicides, organic fungicides, antibiotics and insecticides to find their influence on incidence of Kondli. In half the number of seedlings, spray applications were given at monthly intervals and in the other half seedlings at fortnightly intervals. The details of the treatments and observations on Kondli incidence recorded during September 1960 are summarised in the following table:

Treatments	Percentage disease incidence recorded during July in monthly and fortnightly spray sub-treatments	
	Seedlings sprayed monthly	Seedlings Sprayed fortnightly
Spray with Flit-406—0.4%	nil	nil
„ „ Dithane M-22—0.4%	nil	nil
„ „ Terrachlor—1%	nil	nil
„ „ Flit-407—0.4%	nil	nil
„ „ Bordeaux—1%	83.30	100.00
„ „ Colloidal copper—1 lb. in 40 gals. water	16.70	73.30
„ „ Copper oxychloride—1 lb. in 40 gals. water	nil	50.00
„ „ Spersul—1 lb. in 60 gals. water	nil	nil
„ „ Copper Sulphate solution—$\frac{1}{2}$ lb. in 40 gals. water	nil	20.70
„ „ Agrimycin—200 ppm.	nil	nil
„ „ Folidol E.605—0.02%	nil	nil
„ „ Dieldrin—50% W.P.	nil	nil
Unsprayed control	nil	nil

From the above results it is noticed that no Kondli incidence is noticed in treatments sprayed with non-copper containing formulations as well as in unsprayed control, whereas in all treatments receiving spray with copper containing formulations, Kondli incidence to varying degrees is noticed, the highest being in Bordeaux. In the case of copper oxychloride and copper sulphate treatments, though in monthly application series no Kondli is noticed, its incidence is noticed where sprays were given at fortnightly intervals.

Results from the above two trials clearly show a positive correlation of Kondli incidence with frequent application of Bordeaux or any other copper containing formulation sprayed on nursery seedlings.

F. Varietal susceptibility to Kondli:

To find out whether any varietal susceptibility to Kondli is noticed between different Arabica varieties and Robusta the following trial was conducted during 1960. Healthy seedlings of Coorgs, Kents S.795, S.333, S.288 and Robusta growing in baskets were subjected to Bordeaux spray at monthly intervals, equal number of seedlings in each variety maintained unsprayed being kept as control. Observations on Kondli incidence recorded during September 1960 in the different plots are summarised in the following table:

Treatments		Percentage incidence of Kondli recorded during September 1960	
		Seedlings sprayed with Bordeaux at monthly intervals	Seedlings not sprayed
Coorgs	Arabica	41.70	nil
Kents	„	58.40	„
S.795	„	37.50	„
S.333	„	60.90	„
S.288	„	66.70	„
Robusta		nil	„

It is noticed from the above results that while different Arabica varieties sprayed at monthly intervals showed Kondli incidence, no Kondli was noticed in Robusta whether sprayed with Bordeaux or not.

Some of the above trials are being repeated during this season with slightly modified schedules for confirmation of results. Till end of July 1961, no incidence of Kondli was observed in any of these trials. Further observations are being continued.

2.5. Investigations on Die-back Complex:

Studies on the various aspects of this malady, *viz.*, cause, artificial reproduction and attempts at control were initiated during 1960 pre-monsoon period. The details of these investigations and the results obtained so far are furnished below:

A. Examination and artificial culturing of affected tissues:

Collection of Die-back affected twigs and plant parts showing various types of malformations, microscopic examination and artificial culturing of such affected tissues have been in progress. From these studies, the following observations have been made:

(1) Twigs showing partial or complete blackening and death (at growing apex or only at nodes) revealed association of different micro-organisms, either singly or in combination, *viz.*, *Colletotrichum* types, *Fusarium* sp., *Cladosporium* sp., *Cercospora* sp., *Stemphyllium* sp., *Verticillium* sp., *Diplodia* sp.,

Phoma sp., *Kutilakesopsis* sp., and two types of bacteria. The predominant and consistent organism in isolations belonged to the genus *Colletotrichum.*

(2) Isolations from leaf scars of green and apparently healthy looking branches yielded *Colletotrichum* in culture.

(3) Isolations from nodal and internodal regions where the exterior had turned grey or black (otherwise apparently healthy looking) also yielded *Colletotrichum* when the outer discoloured tissues were also included for isolation; however, in cases, where the outer bark was scraped off and the internal tissues alone put into culture, no organisms developed.

(4) No micro-organisms could so far be detected or isolated from tissues collected from different types of leaf and branch malformations not associated with blackening and/or death of external tissues.

(5) No micro-organisms could so far be detected or isolated from internal tissues showing discolouration and pith disorganisation when not associated with death of external tissues.

Further collections of affected specimens from different sources, their examination and isolation of associated organisms in culture are being continued.

B. Artificial reproduction of the malady:

(a) *Inoculations with micro-organisms isolated from Die-back affected tissues:*

Artificial inoculations were carried out during November-December 1960 period, on different sets of Arabica bushes, using the following organisms isolated from Die-back affected tissues, collected from different sources, *viz.*, 10 isolates of *Colletotrichum*, 2 isolates of *Fusarium*, *Phoma*, *Diplodia*, *Cladosporium* and a bacterial culture as well as surface scrapings from naturally affected twigs. Different sets of inoculations using the above micro-organisms, were carried out on plant material different in age, vigour, shade, condition, etc.

Set 1: Two months old seedlings growing in pots and kept in open exposed conditions were inoculated both to growing apices and lower nodes after mechanically injuring the points of inoculation. In the case of *Fusarium* isolates, soil inoculations were also carried out.

The seedlings were kept under observation till February 1961. No indication of Die-back symptoms was observed in any of the seedlings under trial. The trial was later discontinued.

Set 2: Plants (1956 planting) growing under only dadap shade and showing a certain amount of debility with defoliation and Die-back were selected. Before taking up the inoculations, the dadaps were completely lopped and all Die-back affected twigs were pruned off. Healthy looking tertiary branches were selected at random, labelled and inoculated at growing apices and lower nodes after causing mechanical injury.

Observations on incidence of Die-back were recorded at weekly to fortnightly intervals. Till about middle of February 1961, no fresh cases of Die-back were ob-

served. From the second fortnight of February, a certain amount of Die-back of branches not artificially inoculated was observed, though none of the inoculated branches showed Die-back till March end. Observations in mid April, showed some of the artificially inoculated branches also developing Die-back.

It was noticed from the results that incidence of Die-back on the artificially inoculated branches was seen only in a very few cases, whereas natural incidence on uninoculated branches was observed on most of the plants, right from February onwards, irrespective of the treatment and including the uninoculated control plants. Hence the role of the organisms used for inoculating in causing the Die-back as causative agents appears doubtful.

Set 3: In this trial, bushes showing fairly heavy incidence of leaf disease (1954 planting), growing under a mixed overhead shade canopy and showing considerable defoliation and Die-back was selected. Crop strain and poor soil conditions were visible at start of trial. The Die-back affected branches were pruned off and inoculations were carried out on tertiary branches selected at random during late November 1960.

Observations recorded showed that till end of March 1961, none of the artificially inoculated branches developed Die-back symptoms, though certain amount of natural incidence of Die-back was observed on uninoculated branches in some bushes from mid February onwards. Observations recorded during April 1961 showed a few of the artificially inoculated branches also developing Die-back.

As in the previous trial, though a few cases of the artificially inoculated branches developed Die-back, since uninoculated branches also developed such Die-back even on the uninoculated control bushes, it cannot be presumed that the Die-back observed was due to the introduced organism. Further observations have been discontinued.

Set 4: Another set of artificial inoculations were carried out on ten months old seedlings growing in baskets, using three isolates of *Colletotrichum*, *Fusarium*, *Cladosporium* and a bacterial isolate during the third week of November 1960. Inoculations were done as in previous cases and then the seedlings were incubated at 28°C. under high humidity for a period of two months.

No Die-back symptoms developed during the period of the trial and it was later discontinued.

Set 5: During early December 1960, another set of ten month old seedlings growing in pots were artificially inoculated at growing apices, lower nodes and on leaves by keeping attached naturally affected tissues wound by wet cotton wads. The seedlings were kept under nursery conditions of shade, water, etc.

None of the seedlings showed any symptoms of Die-back till end of April 1961, after which the trial was discontinued.

Set 6: To investigate the possibility of any pathogenic organisms gaining a foothold during the flowering stage and later leading on to Die-back of branches, artificial inoculations using various micro-organisms isolated from Die-back affected tissues were done on the flower buds at different stages of maturity, *viz.*, spike in gum stage (before

occurrence of blossom shower), fairly advanced but still unopened buds (6th day after blossom shower) and fully opened flowers, during March 1961.

So far, no indications of Die-back in any of the inoculated cases are noticed.

(b) *Sap inoculation:*

The plant sap was extracted from plants showing different types of leaf and branch malformations and using this sap, inoculations were carried out on healthy nine months old seedlings growing in pots, during September 1960. The types of malformations reckoned for extracting the sap were plants with (1) thick bluish green leathery foliage, (2) chlorotic leaves, (3) witches broom type of branch growth, (4) branches with short internodes coupled with fan shaped branching, (5) branches with goose neck type of curved growth, (6) branches with bunching growth towards tip, (7) branches showing discolouration and disorganisation of pith, and (8) different types of leaf malformations.

These seedlings were kept under constant observation, but so far, no indication of transmission of the malformations have been noticed. Further observations are being discontinued.

(c) *Graft transmission:*

Using scions collected from plants showing various types of growth malformations as described in previous trial, grafts were taken up on 9 month old seedlings during September 1960. All the grafts failed to establish union and hence no conclusions could be drawn regarding the possibility or otherwise of the graft transmissibility of these growth abnormalities.

(d) One and a half year old plants growing in pots were exposed to hot sun for one week during May 1960 and were kept denied of water. When the plants started showing signs of wilting due to acute water shortage, a very limited quantity of water, just sufficient to moisten the surface half an inch thickness of soil was applied keeping the seedlings in hot sun. Another set of seedlings of the same age kept under good shade and regularly watered was maintained as control. In the first lot, following application of a limited quantity of water, in about three hours time, a black discolouration developed on the petioles of leaves, particularly the functional leaves (the 2nd to 4th pair mostly). This was later followed by later shed of these leaves in about twenty-four hours time and in three to four days time typical symptoms of Die-back, *viz.*, scar development at nodes where defoliation had occurred, dying of twigs from tip as well as from discoloured nodes etc., were noticed.

The above results indicate that an upsetting of the physiological activities of the plant through improper soil moisture status can cause typical Die-back symptoms.

C. Control of Die-back through fungicidal sprays:

In an attempt to find out whether Die-back could be controlled through fungicidal sprays, the following trials were undertaken:

Trial 1:

This trial was started during November 1960 to compare the efficacy of fort-

nightly spray applications of Bordeaux mixture, Flit-407, Agrimycin, Ferbam, Cyprex -65 W and Tuzet fungicide as against an unsprayed control with regard to control of Die-back. Pruning of Die-back affected twigs at commencement of trial and prior to each subsequent spray application formed one of the sub-treatments, whereas in the other affected branches were not pruned off.

Spray applications with the different chemicals and recording of observations were carried out at scheduled intervals. Observations on incidence of Die-back were recorded on tertiary branches originally selected and labelled at start of trial as well as the general incidence on the bushes under trial. These observations recorded from January till June are furnished in Tables 'MY' XIV and XV respectively.

Observations on the selected twigs showed that Die-back incidence was more in the pruned series as compared to the unpruned series irrespective of the treatment applied. Further, it is noticed that Die-back incidence in sprayed bushes is slightly more than in unsprayed bushes. Observations on the general incidence of Die-back on the bushes as a whole do not however show the same trends; the sprayed bushes showed in general lesser Die-back incidence as compared to unsprayed bushes, Bordeaux and Flit-407 sprayed bushes showing the minimum Die-back incidence.

Trial 2:

Another spray trial was started during mid November 1960 with the following chemicals, *viz.*, Ferbam, Flit-407, Dithane M-22, and Bordeaux mixture compared against an unsprayed control. The spray schedule was as follows:

1st spray — Mid November 1960
2nd ,, — Mid February 1961
3rd ,, — Early March — Prior to blossom showers
4th ,, — Late March — 10 days after blossom showers
5th ,, — Mid April — 3 weeks after previous spray
6th ,, — Late August — Tail end of S.W. Monsoon rains
7th ,, — Mid September — 3 weeks after previous spray
8th ,, — Early October — —do—
9th ,, — Late October — —do—

The plant material selected is leaf disease susceptible Kents coffee which had suffered badly from leaf disease incidence, defoliation and Die-back. Prior to start of trial, a hard pruning was given removing all affected branches. At each observation after recording the incidence of Die-back, the affected branches were removed. The results of observations recorded are furnished in Table 'MY' XVI.

The results indicate that repeated sprays with different fungicidal formulations have not helped in controlling Die-back incidence though in Bordeaux treated bushes the Die-back is noticed to be slightly less than in unsprayed control bushes.

In view of the conflicting results obtained in these two spray trials, no conclusions could be drawn regarding the efficacy of spraying with different fungicides for control of Die-back; however, the general trend would appear to be that fungicidal sprays may not cause any appreciable control of this Die-back complex.

Trial 3:

In order to find out the efficacy of application of Para-di-chloro-benzene to the soil in reducing Die-back through control of any possible root pathogens, a trial was started in a private estate in Koppa zone during May 1961. Para-di-chloro-benzene has been applied at the rate of $1\frac{1}{2}$ lbs. to 100 sq. yds. of soil around the collar region of the plants. The treatment of this chemical has been taken up on affected plants and on bushes comparatively free from Die-back. Observations on Die-back incidence recorded in the trial are summarised in Table 'MY' XVII.

It is seen that the Die-back incidence in the plots treated with Para-di-chloro-benzene is comparatively less than in untreated plots.

2.6. Investigations on Damping off of nursery seedlings caused by 'Rhizoctonia solani':

A. Laboratory Studies:

The efficacy of various fungicidal formulations, *viz.*, Bordeaux mixture, Spersul, Eradicant fungicide 0-3818-b, Agrimycin, Tillex, Allisan, Flit-406, Flit-407, Terrachlor and Ferbam in different concentrations in checking growth of *Rhizoctonia solani* was tested in artificial culture media. The results indicated the following:—

(1) No fungitoxicity was noticed with any of these chemicals.

(2) Different concentrations (1%, 0.5% and 0.25%) of Terrachlor and Tillex gave indications of good fungistatic effect; with Bordeaux, Allisan Ferbam and 0-3818-b, fungistatic effect was noticed only in the highest concentration tried (1%). The other chemicals did not show even fungistatic effect.

B. Nursery Studies:

Based on the results obtained in the laboratory studies on control of *Rhizoctonia solani*, nursery trials were also conducted with different chemicals to study their effect on control of damping off of seedlings caused by *Rhizoctonia solani.*

Trial 1:

Efficacy of different fungicides in controlling damping off:

During March 1961, the following fungicides, *viz.*, Flit-406, Flit-407, Terrachlor, Bordeaux mixture and Dithane M-22 were applied as a soil drench to nursery beds with seedlings in cotyledonary leaf stage. Two days after treatment, the soil in the beds were inoculated with artificial culture of *Rhizoctonia solani.* An untreated inoculated plot as well as an untreated uninoculated plot were maintained as controls. Observations on incidence of damping off recorded in the different plots are summarised in the following table:

Treatments	Percentage incidence of damping off recorded at different periods after inoculation			
	15 days after	30 days after	45 days after	60 days after
Flit-406—0.4%	nil	2.50	4.50	6.40
Terrachlor—1%	nil	nil	nil	nil
Inoculated, untreated control	10.00	37.20	44.40	62.10
Flit-407—0.4%	nil	3.80	23.00	56.60
Bordeaux—1%	nil	nil	nil	nil
Dithane M-22—0.4%	nil	nil	4.80	24.00
Uninoculated, untreated control	nil	nil	nil	nil

The above results show that soil application with Terrachlor and Bordeaux mixture have protected the seedlings from infection by *Rhizoctonia solani* for a period of two months, whereas in the inoculated control bed a high disease incidence was observed.

Trial 2:

Efficacy and duration of efficacy of different fungicides in control of damping off:

In order to find out how long the effectiveness of Bordeaux, Terrachlor, Flit-406, Allisan and Tillex would last giving effective protection from damping off disease, a trial was conducted during the current nursery period. Soil application with the above chemicals was carried in pots with seedlings in 'topi' stage. Artificial inoculations with cultures of *Rhizoctonia solani* were carried out on to the soil at intervals of ten days after imposition of treatments. An untreated inoculated and an untreated uninoculated controls were maintained as check plots. Observations on incidence of damping off recorded ten days after each inoculation are summarised in the following table:

Treatments	Percentage damping off in inoculations at 10 days interval after treatment, recorded 10 days after each inoculation				
	10 days	20 days	30 days	40 days	50 days
Bordeaux—1%	nil	nil	50.00	65.00	15.00
Terrachlor—1%	nil	nil	nil	nil	5.00
Flit-406—0.4%	100.00	100.00	80.00	95.00	80.00
Allisan dust—4%	Phytotoxicity noticed and hence, no observations on damping off recorded				
Tillex—0.1%	-do-				
Untreated inoculated control	70.00	100.00	95.00	100.00	20.00
Untreated uninoculated control	nil	nil	nil	nil	nil

From the above results it is noticed that soil application with Terrachlor gave protection from damping off incidence for about 40 days after which period a slight incidence was noticed. In the case of Bordeaux, the effective toxicity duration is only 20 days. In untreated, inoculated control and Flit-406 treatment, a high incidence of damping off was noticed. Treatment with Allisan and Tillex resulted in phytotoxicity.

Trial 3:

Incidence of damping off in relation to age of seedlings:

To find out whether different age groups of seedlings showed difference in susceptibility to damping off, a trial was conducted under artificial infection conditions. The details of the trial and observations recorded are furnished in the following table:

Treatments	%age incidence of damping off observed 5 days after inoculation	%age affected and dead observed 3 months after start of trial	%age affected but recovered
Topi stage seedlings inoculated	100.00	95.00	5.00
Cotyledonary leaf stage seedlings inoculated	100.00	75.00	25.00
1 pair true leaf stage seedlings inoculated	90.00	72.22	27.77
2 pairs true leaves stage seedlings inoculated	nil	—	—
Uninoculated control	nil	—	—

From the above, it is noticed that seedlings are more susceptible to damping when they are either in topi or cotyledonary leaf stage. Seedlings with the second pair of true leaves did not take up infection. A certain amount of recovery even after infection taking place is noticed as the seedling ages.

GEORGE, K. V.,
Mycologist

TABLE 'MY' I

Experiment to Compare the Efficacy of Eradicant Fungicide 0-3818-b with Bordeaux Mixture

Locality: Coffee Research Station, Balehonnur. *Year of start:* May 1959.

Treatments	Effective percentage of leaf survival				
	May 1959 (initial)	September 1959	February 1960	September 1960	February 1961
A. Unsprayed control	99.40	38.10	7.00	24.50	15.63
B. Eradicant fungicide 0-3818-b, 0.35%, 4 sprays	99.70	44.20	7.50	31.70	20.10
C. Eradicant fungicide 0-3818-b, 0.175%, 4 sprays	99.60	46.20	7.90	38.00	18.23
D. Bordeaux, 0.5%, 2 sprays	99.60	55.20	8.90	36.70	23.51
General mean		45.90	7.80	32.72	19.37
S.E.M.		5.11	1.13	4.25	1.34
Significance		No	No	No	Yes*
Conclusions		—	—	—	D B C A
Critical Difference		—	—	—	4.28

TABLE 'MY' II

Spray Experiment to Compare the Efficacy of Proprietary Fungicides with Bordeaux Mixture

Locality: Coffee Research Sub-Station, Chethalli (Coorg).
Layout: Randomized.
Plot size: Gross — 3 × 5 = 15 plants.
Net — Middle 3 plants.

Started in: May 1957.
Replications: 4.
Treatments: 9.

Treatments	Effective percentage of leaf survival						
	Septr. 1957	Febr. 1958	Septr. 1958	Febr. 1959	Septr. 1959	Febr. 1960	Sept. 1960
A. Flit-406, 0.2%, 2 sprays	84.18	34.70	66.60	68.90	66.30	49.10	41.07
B. -do- 0.4%, ,,	82.62	35.75	71.20	70.00	66.90	54.70	40.70
C. -do- 0.6%, ,,	80.20	35.50	57.10	64.50	68.90	42.90	38.47
D. -do- 0.4% *plus* Tenac, 2 sprays	78.62	37.56	61.90	65.50	65.90	50.70	40.30
E. Bordeaux, 0.5%, 2 sprays	86.72	42.25	64.50	72.00	72.30	53.50	55.72
F. Bordeaux, 0.5% *plus* Tenac, 4 sprays	84.54	40.25	71.10	57.80	70.90	52.30	47.80
G. Kirti copper, 1 lb. in 40 glns., 2 sprays	69.65	33.90	64.90	58.90	62.60	62.30	47.17
H. Unsprayed control	68.75	29.40	59.00	72.70	51.10	56.80	56.00
I. Flit-406, 0.4% *plus* Tenac, 4 sprays	82.40	40.38	66.90	62.60	61.00	48.30	59.25
General mean	79.74	36.62	64.80	65.80	65.11	52.30	47.35
S.E.M.	0.73	3.81	6.01	6.16	4.65	4.43	7.28
Significance	Yes	No	No	No	No	No	No
Critical Difference	2.13	—	—	—	—	—	—
Conclusions	E F A B I C D G H						

TABLE 'MY' III

Spray Experiment to Compare Efficacy of Proprietary Fungicides with Bordeaux Mixture

Locality: Coffee Research Sub-Station, Chethalli.
Plot size: Gross—3 × 3 = 9 plants.
Nett—Middle plant.
Layout: Randomized.
Started in: May 1958.
Replications: 5.
Treatments: 8.

Treatments	Effective percentage of leaf survival	
	September 1960	February 1961
A. Cobredon—17.6 oz. in 40 glns. water—2 sprays	40.34	76.48
B. Cupricol—1 lb. in 40 glns. water—2 sprays	24.96	73.50
C. Parrycop—1 lb. in 40 glns. water—2 sprays	40.76	79.24
D. Dithane-M22—0.4% in 40 glns. water—2 sprays	35.24	73.74
E. Bordeaux 0.5% in 40 glns. water—2 sprays	45.38	79.50
F. Bordeaux 0.5% + Triton X-114 Sticker—2 sprays	42.76	77.48
G. Dithane-M22—0.4%—4 sprays	29.06	74.48
H. Unsprayed control	28.94	78.24
General mean	33.43	76.58
S.E.M.	6.55	10.44
Significance	No	No

TABLE 'MY' IV

Experiment to compare the Efficacy of Proprietary Fungicides with Bordeaux Mixture

Locality: Woodlands Estates, Coonoor.
Layout: Randomized.
Plot size: Gross—20 × 5 = 100 plants
Nett—18 × 3 = 54 plants.
Started in: 1958 post-monsoon
Replications: 4.
Treatments: 4.

Treatments	Effective %age of leaf survival—September 1960	Yield of ripe cherry in lbs./acre—1960-61
A. Cupricol—1 lb. in 40 glns.—2 sprays	57.53	171
B. Kirti copper -do- -do-	51.22	183
C. Micricop -do- -do-	54.47	172
D. Bordeaux mixture 0.5% -do-	62.75	227
General mean	56.36	188
S.E.M.	4.37	3.46
Significance	No	No

TABLE 'MY' V

Spray Experiment to Compare the Efficacy of Proprietary Fungicides with Bordeaux Mixture

Locality: Pillavalli Estate, Pulneys. **Started in:** September 1958.
Layout: Randomized. **Replications:** 4.
Plot size: Gross —10 × 10 = 100 plants. **Treatments:** 4.
Nett— 8 × 8 = 64 plants.

	Treatments	Effective %age of leaf survival— September 1960	Yield of ripe cherry in lbs./acre— 1960-61
A.	Colloidal copper 1 lb. in 40 gins. water 2 sprays	41.70	1,636
B.	Bordeaux 0.5% + Tenac sticker 2 sprays	45.87	1,772
C.	Cobredon 17.6 oz. in 40 gins. water 2 sprays	51.75	1,504
D.	Bordeaux 0.5% -do-	48.87	1,856
	General mean	47.04	1,692
	S.E.M.	6.08	21.07
	Significance	No	No

TABLE 'MY' VI

Spray Experiment to Compare the Efficacy of Proprietary Fungicides with Bordeaux Mixture

Locality: Bonaventura Estate, Shevaroys. **Started in:** September 1958.
Layout: Randomized. **Replications:** 4.
Plot size: Gross:—20 × 5 = 100 plants. **Treatments:** 3.
Nett:—18 × 3 = 54 plants.

	Treatments	Effective %age of leaf survival— September 1960	Yield of ripe cherry in lbs./acre— 1960-61
A.	Bordeaux mixture; 0.5%; 2 sprays	63.07	7,044
B.	Flit-406; 0.4%; 2 sprays	60.50	6,616
C.	Parrycop-50; 1 lb. in 40 gins. water; 2 sprays	51.00	6,883
	General mean	58.40	6,847
	S.E.M.	3.24	869
	Significance	No	No

TABLE 'MY' VII

Spray Experiment to Compare the Efficacy of Proprietary Fungicides with Bordeaux Mixture

Locality: Coffee Research Sub-Station, Chethalli (Coorg).
Plot size: Gross—20 × 5 = 100 plants.
Nett—18 × 3 = 54 plants.
Layout: Randomized.
Started in: September 1958.
Replications: 3.
Treatments: 4.

Treatments	Effective %age of leaf survival		Yield of ripe cherry in lbs./acre
	Sept. 1960	Feb. 1960	1960-61
A. Microcop; 1 lb. in 40 glns. water	36.43	81.50	4,822
B. Bordeaux; 0.5%	37.23	83.43	5,244
C. Colloidal copper; 1 lb. in 40 glns. water	41.43	86.13	5,681
D. Ultra-sulphur; 1 lb. in 60 glns. water	32.96	85.06	2,888
General mean	37.01	84.03	4,658
S.E.M.	5.65	2.59	651
Significance	No	No	No

TABLE 'MY' VIII

Spray Experiment to Compare the Efficacy of Proprietary Fungicides with Bordeaux Mixture

Locality: Cheekanahally Estate, Saklespur.
Layout: Randomized.
Plot size: Gross—20 × 5 = 100 plants.
Nett—18 × 3 = 44 plants.
Started in: 1959 pre-monsoon
Replications: 4.
Treatments: 4.

Treatments	Effective %age of leaf survival—September 1960	Yield of ripe cherry in lbs./acre—1960-61
A. Flit-406—0.4%	29.70	664.50
B. Bordeaux—0.5%	38.10	998.50
C. Bordeaux—0.5% **plus** Tenac sticker	47.10	851.20
D. Cupricol—1 lb. in 40 glns. water	33.30	566.70
General mean	37.20	770.22
Significance	No	No

TABLE 'MY' IX

Spray Experiment to Compare the Efficacy of Proprietary Fungicides with Bordeaux Mixture

Locality: Vasanthacool Estate, Chikmagalur. Started in: 1959 pre-monsoon.
Layout: Randomized. **Replications:** 4.
Plot size: Gross—20 × 5 = 100 plants. **Treatments:** 4.
Nett—18 × 3 = 54 plants.

Treatments	Effective %age of leaf survival— Sept. 1960	Feb. 1961	Yield of ripe cherry in lbs./acre— 1960-61
A. Parrycop-50—1 lb. in 40 glns. water	81.40	6.20	1,510.20
B. Bordeaux 0.5%	84.00	14.50	1,455.50
C. Cobredon—17.6 oz. in 40 glns. water	78.50	12.50	1,547.50
D. Kirti copper—1 lb. in 40 glns. water	89.40	10.30	1,105.20
General mean	83.33	10.87	1,404.60
Significance	No	No	No

TABLE 'MY' X

Spraying of Leaf Disease Resistant Selections

Locality: Kerkkikonda Estate. **Started in:** 1959 pre-monsoon
Layout: Bulk observational trial. **Treatments:** 5.
Plot size: One acre plots. **Sub-Treatments:** 2.

Treatments	S.333 arabica		S.288 arabica	
	Yield of ripe cherry in lbs./acre 1959-60 (initial)	1960-61	1959-60 (initial)	1960-61
A. Normal under surface spray with 0.5% Bordeaux	2,621	1,590	2,523	2,000
B. Normal spray with 1% Bordeaux	1,734	1,201	1,959	1,265
C. Normal spray with 2% Bordeaux	1,770	1,006	1,105	1,065
D. Top spray with 2% Bordeaux	2,021	1,723	1,254	2,284
E. Unsprayed control	1,422	1,058	1,370	618

TABLE 'MY' XI

Spraying of Leaf Disease Resistant Selections

Locality: Coffee Research Sub Station, Chethalli

Layout: Randomized.

Plot size: Gross—5 × 20 = 100 plants.

Net—3 × 18 = 54 plants

Started in: June 1959

Replications: 4

Treatments: 5.

Treatments	E.P.L.S. during September 1960	Percentage of cropping tertiary branches produced on each secondary branch	Percentage of cropping nodes produced on each secondary branch	Yield of ripe cherry in lbs./acre	
				1959-60 (basic)	1960-61
A. Bordeaux—0.5% normal spray—2 rounds	92.37	3.15	14.30	4,587	9,250.50
B. -do- 1% -do-	92.80	3.80	17.20	5,226	8,940.50
C. -do- 2% -do-	92.50	3.45	16.20	4,386	6,556.25
D. Fil-406—0.4%—4 sprays	90.50	3.60	16.05	3,848	7,967.50
E. Unsprayed control	89.40	3.80	15.75	5,287	10,337.50
General mean	91.50	3.56	15.90		8,810.00
S.E.M.	1.80	0.44	9.30		1,078.00
Significance	No	No	No		No

TABLE 'MY' XII

Spray Experiment to Compare Effects of Spraying the Upper Surface of Leaves with Normal Under Surface Spraying

Locality: Coffee Research Station, Balehonnur.

Started in: May 1959.

Layout: Randomized.

Replications: 4.

Plot size: Gross—5 × 8 = 40 plants.

Nett—3 × 6 = 18 plants.

Treatments: 5.

Treatments	Effective percentage of leaf survival		Yield of ripe cherry in kilos per acre—1960-61
	September 1960	February 1961	
A. Unsprayed control	20.60	13.45	669
B. Bordeaux 2:2:40 normal under surface spray	30.20	16.64	1,226
C. Bordeaux 2:2:40 upper surface spray	23.50	21.73	1,003
D. Bordeaux 4:4:40 upper surface spray	28.10	18.86	1,483
E. Bordeaux 8:8:40 upper surface spray	35.60	25.87	1,108
General mean	27.61	19.31	1,097.90
S.E.M.	4.47	0.69	228.19
Significance	No	Yes	No
Conclusions	—	E > C > D > B > A	—
Critical difference	—		—

TABLE 'MY' XIII

Frequency and Timing of Spray

Locality: Coffee Research Station, Balehonnur.

Started in: March 1960.

Layout: Randomized.

Replications: 4.

Plot size: Gross—5 × 10 = 50 plants.

Nett—3 × 8 = 24 plants.

Treatments: 9.

Treatments	Effective percentage of leaf survival—February 1960	Yield of ripe cherry in kilos/acre—1960-61 (basic)
A. Spray every three pairs of new leaves formed	19.19	2,910.40
B. Five sprays—2 pre, 1 mid and 2 post-monsoon	20.40	2,663.60
C. Four sprays—2 pre, 2 post-monsoon	19.15	2,885.60
D. Four sprays—1 pre-blossom, 1 pre and 2 post-monsoon	25.44	2,358.00
E. Three sprays—1 pre, 1 mid and 1 post-monsoon	19.88	1,960.70
F. Three sprays—2 pre and 1 post-monsoon	21.36	1,936.40
G. Three sprays—1 pre-blossom, 1 pre and 1 post-monsoon	23.79	1,985.30
H. Three sprays—1 pre and 2 post-monsoon	22.15	2,219.70
I. Control—2 sprays—1 pre and 1 post-monsoon	19.40	2,121.30

TABLE 'MY' XIV

Trial on Control of Die-back Complex through Fungicidal Sprays

Locality: Coffee Research Station, Balehonnur.

Started in: November 1960.

Layout: Randomized.

Replications: 4.

Plot size: 1 plant per sub-treatment.

Treatments: 7.

Plant material: Leaf disease resistant Arabica.

Sub-Treatments: 2.

Treatments	Number of labelled tertiary branches which developed Die-back out of a total of 52 branches on 4 plants													
	Sub-treatment 1: Die-back branches pruned of							Sub-treatment 2: Die-back branches not pruned of						
	Jany. 1961	Feb. 1961	March 1961	April 1961	May 1961	June 1961	Total No. affected	Jany. 1961	Feb. 1961	March 1961	April 1961	May 1961	June 1961	Total No. affected
Ferbam	Nil	1	Nil	3	Nil	Nil	4	Nil	Nil	3	2	Nil	Nil	5
Flit-407	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Agrimycin	„	„	1	10	„	„	11	„	„	3	2	„	„	5
Cyprex 65-W	Discontinued as phytotoxicity causing leaf scorch, defoliation and Die-back was observed													—
Tuzet fungicide	-do-							-do-				-do-		
Bordeaux mixture	Nil	Nil	Nil	Nil	4	Nil	4	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Control—untreated	„	„	3	„	Nil	„	3	„	„	„	„	„	„	„

TABLE 'MY' XV

Trial on Control of Die-back Complex through Fungicidal Sprays

Locality: Coffee Research Station, Balehonnur.

Started in: November 1960.

Layout: Randomized.

Replications: 4.

Plot size: 1 plant per sub-treatment.

Treatments: 7.

Plant material: Leaf disease resistant Arabica.

Sub-Treatments: 2.

Treatments	Total number of tertiary branches which developed Die-back on 4 plants under each treatment in the pruned series						
	January 1961	February 1961	March 1961	April 1961	May 1961	June 1961	Total No. of branches affected
Ferbam	4	13	6	18	11	4	56
Flit-407	3	4	3	24	7	9	50
Agrimycin	8	8	15	63	43	9	146
Cyprex 65-W	———	———	Discontinued due to phytotoxicity	———	———	———	
Tuzet fungicide	———	———	-do-	———	———	———	
Bordeaux mixture	7	3	1	5	20	6	42
Control—unsprayed	11	4	53	40	20	19	147

TABLE 'MY' XVI

Trial on Control of Die-back Complex through Fungicidal Sprays

Locality: Coffee Research Station, Balehonnur.

Started in: November 1960.

Layout: Randomized.

Replications: 4.

Plant material: Leaf disease susceptible Arabica.

Treatments: 5.

Plot size: Gross—4 × 4 = 16 plants.

Nett—2 × 2 = 4 plants.

Treatments	Number of tertiary branches which developed Die-back on 16 bushes under each treatment					Total No. of branches affected on 16 bushes
	February	March	April	May	June	
Ferbam	33	40	9	6	18	106
Flit-407	22	29	15	3	4	73
Dithane M-22	45	76	26	19	9	175
Bordeaux	9	18	12	10	5	54
Control	11	30	18	6	7	72

TABLE 'MY' XVII

Trial on Control of Die-back Complex through Soil Application of Para-dichloro-Benzene

Locality: Maduba Estate, Koppa. Started during: First fortnight of May 1961.

Treatments	Total number of tertiary branches affected with Die-back on 5 plants					Total No. of affected branches on 5 plants
	May 1st fortnight (initial)	May 2nd fortnight	June 1st fortnight	June 2nd fortnight	July 2nd fortnight	
A_1 — Plants showing heavy Die-back —Para-dichloro-benzene applied at 1½ lbs./100 sq. yards	78	20	18	nil	7	45
B_1 — Plants showing heavy Die-back —No Para-dichloro-benzene applied	81	35	21	3	3	62
A_2 — Plants showing mild Die-back —Para-dichloro-benzene applied at 1½ lbs./100 sq. yards	8	5	3	nil	2	10
B_2 — Plants showing mild Die-back —No para-dichloro-benzene applied	15	1	4	4	5	14

VI. EXTENSION (ADVISORY) SERVICE

Salient features of work in individual Liaison Divisions and Districts are summarised below.

2. North Mysore Division:

2.1. North Mysore Division with its headquarters at Hassan, comprising of the Liaison Districts of Mudigere, Chikmagalur and Saklespur, continued to be in charge of Shri B. K. Chandrappa, Senior Liaison Officer. In addition to supervisory functions over the Liaison Districts, the Senior Liaison Officer was in direct charge of his personal contact zone in the Alur Taluk of Hassan District.

2.2. Incidence of pests and diseases in the Division was not significant except for sporadic outbreaks in stray patches. The setting of the monsoon earlier than usual and continuous and heavy rains thereafter interrupted the post-blossom and pre-monsoon operations in many estates resulting in a severe incidence of leaf disease towards the end of July 1961. Timely control measures advocated and adopted have reduced the sporadic incidence of white stem borer. The incidence of green bug reported in the previous report was controlled by timely protective operations. The incidence of nursery diseases—collar rot and 'Kondli'—was negligible. Field studies and observations on the new type of Die-back were continued. The malady was noticed in a mild form in a number of estates but the plants recovered later.

2.3. Fifty individual pulping units were established in this Division during the year. All these units as also the four co-operative pulping units and 16 individual units established in the previous years functioned satisfactorily and undertook pulping operations. The extension staff paid periodical visits to these units and gave technical guidance and advice in the proper processing methods.

2.4. The Senior Liaison Officer was on tour for 188 days visiting 365 estates. He addressed 16 group gatherings of planters and contacted 560 planters during his itinerary. Nearly 500 advisory notes were issued. Fifteen follow up visits were paid by him to loan aided estates in addition to spot inspection of holdings of 3 fresh applications.

2.5. *Mudigere Liaison District:*

2.5.1. Shri K. T. Bhagat, Junior Liaison Officer, was in charge of this District till he resigned his post on 17-1-1961. The Senior Liaison Officer, Hassan, held additional charge of the District assisted by a Liaison Assistant. Shri Mohamed Sheriff, took charge as Junior Liaison Officer on the 13th June 1961 and continued to be so at the end of the year under report.

2.5.2. The year experienced good blossom showers.

2.5.3. Blossom showers during 1961 were received in time and in good quantities resulting in a successful blossom. The setting of the Robusta has not been very satisfactory. The heavy and continuous precipitation during June and July 1961 have

caused considerable damage to coffee land and loss in crop by landslides, falling of shade trees, etc.

2.5.4. The incidence of the new malady 'Die-back' on coffee was reported in a fairly severe form from a number of estates during September and October. Observations and field trials are in progress.

2.5.5. Critical studies on the field performance of Station Selections were undertaken in selected estates. The Selections S.795 and S.288 establish well in varying types of soils, rainfall conditions and shade pattern and with different cultural operations.

2.5.6. Eleven demonstration plots, 7 re-orientation plots, 4 differential manurial blocks, 7 exploratory trials and one Robusta manurial trial were in operation during the year. Kenyan method of crop estimation was undertaken in 2 estates.

2.5.7. A quantity of 890.00 litres of seed coffee was distributed to 235 planters.

2.5.8. Eight group discussions were held to discuss various problems affecting coffee and 21 demonstrations were conducted.

2.5.9. Seventy-four follow up visits were paid by the extension staff to 45 loan aided estates in the District. Thirty-four applications for grants-in-aid were investigated.

2.5.10. The Liaison Officer and his staff were on tour for 368 days visiting 321 estates. In addition to the on the spot suggestions and recommendations offered, advisory notes were issued in over 250 cases.

2.6. *Saklespur Liaison District:*

2.6.1. Shri K. Haridas Menon, Junior Liaison Officer, continued to be in charge of the District till March 1961. On his transfer to Pulneys, Shri M. A. Balasubramaniam took charge on the 7th March 1961.

2.6.2. The year experienced a record rainfall of 3287.7 mm. of rain from August 1960 to July 1961. Good blossom showers were received in time. The setting of Arabica coffee was satisfactory. Setting of Robusta was observed to be poor. The early setting of the monsoon in a very severe form and the heavy gale have caused some damage to coffee estates and crop.

2.6.3. The incidence of pests and diseases was almost negligible excepting for sporadic occurrence in a few estates. The incidence of thrips was noticed to be severe over a very wide area under diverse conditions of shade, soil and cultural practices.

2.6.4. Intensive survey was conducted to assess the extent of the new malady 'Die-back' and to find out the probable causative agent. Six composite demonstration plots opened during 1959-60 were continued during the year to ascertain whether this malady could be controlled by building up plant vigour.

2.6.5. A total of 20 demonstration, different manurial, simple manurial and plant protection trials were functioning in the District. The yield levels in almost all the demonstration plots have been stepped up to 4 to 6 Cwt. to an acre from the pre-demonstration level of below 1 Cwt. per acre.

2.6.6. Thirty-nine fresh cases for loan aids were inspected for furnishing reports on the suitability of the holdings for improvements by financial assistance. There are 50 loan aided estates in the District. Calendar of operations were furnished to these estates and periodical follow up visits to assess the progress against programmes given were undertaken.

2.6.7. One thousand five hundred and three litres of seed coffee were distributed to 178 planters and other Liaison Districts.

2.6.8. The Junior Liaison Officer was on tour for 208 days visiting 239 estates. He addressed 50 meetings and issued 110 advisory notes. Over 80 demonstrations on improved methods of coffee culture were conducted.

2.7. *Chikmagalur Liaison District:*

2.7.1. Shri H. S. Puttaswamy, Junior Liaison Officer, continued to be in charge of the District till 7-4-1961 when he resigned. Shri H. T. Ranga Shetty, Junior Liaison Officer, took over and held charge from 23-5-1961. During the interim period, the activities of the District were directly looked after by the Senior Liaison Officer, Hassan.

2.7.2. Blossom showers were received in time and in sufficient quantities. The backing showers were also satisfactory. The early setting of the monsoon and heavy and continuous rainfall combined with heavy winds in June-July 1961 have caused some damage to the crop and coffee land.

2.7.3. Excepting for a noticeable incidence of white stem borer which was kept under check by timely control measures the incidence of other pests and diseases was at a minimum.

2.7.4. Twenty-one demonstration and other plots were functioning in the District. Kenyan method of crop estimation was undertaken in one estate.

2.7.5. A total quantity of 1207.02 litres of seed coffee was distributed to growers.

2.7.6. The Junior Liaison Officer was on tour for 146 days and visited 315 estates and contacted 1040 planters. Eighteen group gatherings were addressed and advisory letters issued to 185 growers. Eighty-six follow up visits were paid to 38 loan aided estates. One hundred and sixty demonstrations on the improved methods of cultivation were conducted.

3. South Mysore Division:

3.1. Shri G. I. D'Souza, Senior Liaison Officer, was in charge of this division comprising of North Coorg, South Coorg, North Wynaad and South Wynaad Liaison Districts. He proceeded on leave from 1st September 1960 for higher studies abroad. Shri W. Raghavendra Rao and Shri R. Vijaendraswamy were in additional charge from 1-9-1960 to 21-11-1960 and 22-11-1960 to 27-3-1961 respectively. Shri S. J. Mathias took charge of this division on 27-3-1961 and continued for the rest of the period.

3.2. Climatic conditions were very favourable during the year and a record crop of coffee was harvested. The blossom showers were adequate, timely and well distri-

3.7.6. He toured for 207 days, visited 213 estates, conducted 230 demonstrations in the estates and participated in 3 meetings of planters. Advisory correspondence totalling 1,840 on various matters connected with coffee culture was attended to.

3.8. *North Wynaad Liaison District:*

3.8.1. Shri M. A. Balasubramaniam was in charge of this zone till 24-2-1961 when he was relieved by Shri P. K. Ramachandran transferred from Kottayam. The latter continued for the rest of the period except from 8-6-1961 to 19-7-1961 when he was holding charge of Shevaroy's Zone on temporary transfer. Shri H. Hanumantha Rao was in additional charge during this interim period.

3.8.2. A total rainfall of 149.52 inches was recorded on 139 rainy days. Weather conditions were rather unusual. Both South-West and North-East Monsoon were heavier than in the previous years interrupting the normal seasonal estate operations. Blossom showers followed by adequate backing showers brought fairly satisfactory, even and healthy blossoms all over the District. Maturity, development of crop and the general health of the plants were quite normal.

3.8.3. This is predominantly a Robusta area. Planting of Station Selections has recently been introduced. Absence of diligent control and preventive measures have resulted in heavy incidence of shot hole borer on Robusta coffee. The incidence of white stem borer on Arabica remained below pest level. The damage caused by red borer, green bug, mealy bug, cercospora and collar rot was not of economic significance.

3.8.4. Four additional demonstration blocks were opened during the year bringing the total number to 12. These blocks provided visual aid to a large number of small growers who visited frequently for timing the various cultural operations for improvement of their own holdings. A simple manurial plot in an Arabica estate and a re-orientation block in a medium sized Robusta holding was started.

3.8.5. Fifteen follow up visits were made to the loan aided estates. Six applications for grant-in-aid were investigated and 5 estates were given calendar of operations. A total quantity of 359.89 litres of Station Selections seed coffee was distributed to 71 planters.

3.8.6. The difficulties in obtaining adequate quantities of straight and mixed fertilisers continued to exist during the year.

3.8.7. He visited 200 estates during the 174 days of tour, met 287 planters and addressed 57 group gatherings. During the year, 7 demonstrations were conducted and 53 advisory services rendered.

3.9. *South Wynaad Liaison District:*

3.9.1. Shri H. Hanumantha Rao, Junior Liaison Officer, continued to hold charge of the District throughout the year. The Office of the Junior Liaison Officer was shifted on 15-3-1961 to the newly constructed office building at the Coffee Demonstration Farm.

3.9.2. An unusual drought was experienced from December 1960 to the end of March 1961 causing severe parched condition in both Arabica and Robusta with a

marked scorching in the latter. Blossom showers were ample followed by sufficient backing showers. July 1961 recorded extremely heavy downpour accompanied by strong winds. The rainfall in July 1961 was 83.29 inches against the decennial average of 39.18 inches. On account of this, about 40 acres of coffee were damaged by landslides and floods. The total rainfall for the year (August 1960 to July 1961) was 207.89 inches as against the decennial average of 164.57 inches.

3.9.3. Periodic heavy build up of shot hole borer on Robusta was observed causing considerable damage to the cropping wood. Eelworm was confined to three blocks in one estate. Isolation, trenching and application of organic manures were recommended and adopted as immediate first aid measures. Pink disease, leaf and berry cercospora were found to be on the increase.

3.9.4. Out of the 12 demonstration blocks laid out in peasant farmers holdings under the accelerated programme of demonstration of improved coffee culture, 2 which had attained maturity were taken away from departmental subsidy and direct supervision. These latter continued to be worked by the planters as per the schedule of operations furnished by the extension staff. Re-orientation blocks, manurial and varietal trials opened in 1955 and 1956 in private holdings continued to function. The yield levels in the demonstration and re-orientation plots are steadily stepping up. The pre-demonstration yields which averaged at 1 to 2 Cwt. per acre now stand at 5 to 6 Cwt. to an acre.

3.9.5. Being predominantly a Robusta area, the District had only about half an acre under Arabica in 1953. Due to the intensive propaganda carried out by the extension staff and by arranging visits for the progressive planters to Arabica plantations especially of Station material in Mysore and Coorg, a gradual switching over to Arabica cultivation was initiated from 1954. The progressive implementation of this programme is featured below:

Year	Arabica (Station Selections) Area under
1953	0.60 acres
1954	1.62 ,,
1955	57.02 ,,
1956	224.28 ,,
1957	371.00 ,,
1958	720.69 ,,
1959	914.64 ,,
1960	1,235.89 ,,

A further extent of 500 acres are expected to be planted during the 1961 planting season.

3.9.6. As a result of field observations on the growth and vigour and the initial yield performances over the past 8 years, it can safely be said that the soil and climatic conditions of Wynaad are well suited for growing of Arabica Station Selections.

3.9.7. The off-take of fertilizers during the year was 2,500 tons. The difficulty however continued to exist for the small growers to obtain in proper time their small requirements of straight or mixed fertilizers.

3.9.8. A quantity of 662.76 litres of seed coffee was distributed to 138 planters.

3.9.9. Seventy-two applications for loan aid under the Development Plan were investigated during the year. One hundred and seventy-two follow up visits were undertaken to the loan aided estates to assess and review the progress against programmes given. Calendar of operations drawn up to suit individual holdings were issued to 91 estates which had received financial assistance from the Board.

3.9.10. The Junior Liaison Officer toured for 205 days and visited 325 estates. On the spot suggestions for adoption of improved techniques of cultural, protective and manurial applications, were offered. In addition to addressing 9 group gatherings of planters where the current problems and the future programmes were discussed and views exchanged, over 300 advisory notes were issued to estates of different categories. Seventy demonstrations on the recommended cultivation practices were conducted in the planters' fields.

4. Coimbatore Liaison Division:

4.1. Shri T. V. Pattabhiraman, Senior Liaison Officer, held charge of this Division till 26-4-1961 when he retired from service. Shri W. Raghavendra Rao, Senior Liaison Officer(Devt.) was in charge for just over a month till 3-6-1961. Shri K. R. Ahobala Rao, Junior Liaison Officer, Nilgiris, has been holding additional charge of the activities of the Division from 3-6-1961. This Division directly attended to the extension work in Biligiris, Anamalais, Nelliampathies and Singampatty areas comprising roughly of 9,600 acres of mostly Arabica. The Liaison Districts of Nilgiris, Pulneys and S. Kerala were in the supervisory jurisdiction of the Division.

4.2. This Division has both the South-West and North-East Monsoon coffee tracts, the major portion however lying in the latter. The season was generally good for the proper development of crop and growth of plants.

4.3. The formulation and adoption of the revised schedule of cultural practices to suit the North-East Monsoon conditions have stepped up the production and at the same time helped in evening out of the crop from year to year.

4.4. There had been no serious or wide-spread incidences of any pests or diseases. Sporadic outbreaks of leaf disease, green bug and white stem borer noticed in isolated areas were kept under check by timely adoption of control measures.

4.5. Two individual pulping units were established in this Division during the year.

4.6. The Senior Liaison Officer was on tour for 150 days. He visited 146 estates and contacted 294 planters. Discussions and exchange of views on the zonal problems were continued to be held with groups of planters during his itineration.

4.7. *Nilgiris Liaison District:*

4.7.1. Shri K. R. Ahobala Rao, Junior Liaison Officer, continued to be in charge of the Nilgiris Liaison District throughout the year.

4.7.2. This District extends over both the North-East and South-West Monsoon zones. The total rainfall for the period August 1960 to July 1961 in the North-East zone ranged from 80 to 110 inches. The rainfall was active throughout October and November 1960 recording over 40 inches in the second fortnight of October 1960. This unusual heavy rain with prolonged wet weather conditions till December not only dislocated routine estate operations like manuring and plant protection measures, but also resulted in leaf shed and berry drop. The total rainfall in the South-West Monsoon zones ranged from 80 to 150 inches. The blossom and backing showers were adequate bringing forth a successful blossom.

4.7.3. Except for heavy incidence of leaf disease, green bug, white stem borer and shot hole borer in isolated patches, the pests and diseases' position in the District as a whole was not of any serious concern.

4.7.4. Six demonstration blocks which had attained maturity were closed down and new blocks opened. There were 12 demonstration blocks and 8 re-orientation blocks, in operation at the end of the year under report. As a result of propaganda carried out through these demonstration centres, and by organising small coffee growers forum, addressing and contacting groups of planters, a wide cross section of the planting community has taken to the improved techniques of coffee cultivation and upgraded their holdings both in the growth and vigour of the plants and in yield. The 3 differential manurial, 1 Robusta manurial, 1 weedicidal (using 'Dowpon') and 1 leaf disease control trial were also in operation in the District.

4.7.5. A total quantity of 413 litres of seed coffee was distributed to 52 planters. The Junior Liaison Officer was on tour for 223 days visiting 302 estates and contacting 486 planters. He addressed 8 meetings of planters and conducted 50 demonstrations in the planters' fields. Over 400 advisory notes were issued in person and by correspondence. Six applications for loan under the Development Plan were investigated. Fifteen follow up visits were paid to the loan aided estates.

4.8. *Pulneys Liaison District:*

4.8.1. Shri S. J. Mathias, Junior Liaison Officer, was in charge of the District till 17-3-1961 when Shri K. Haridas Menon, Junior Liaison Officer, took over.

4.8.2. The climatic conditions throughout the year were good for the proper development of crop and for the growth of the plants in general.

4.8.3. Blossom showers were ample followed by sufficient backing showers in most of the areas. The crop for 1961-62 is estimated at 2,990 tons of Arabica and 500 tons of Robusta.

4.8.4. The incidence of pests and diseases was mild and the sporadic outbreaks in certain isolated pockets were kept under check by timely protection measures.

4.8.5. The performance of Station Selections is very encouraging in the District. Their yield in well maintained estates ranges from 7 to 15 cwts. of clean coffee to an acre.

4.8.6. On account of intensive extension work carried out in this District, about 70% of the holdings of all categories are adopting all the improved techniques of cultivation inclusive of timely and adequate fertilizer applications and plant protection measures. The result of this is evidenced by the present crop yield in the District ranging between 3,500 to 4,000 tons as against 1,000 tons prior to the setting up of the extension service in the area, without any appreciable increase in the acreages under coffee.

4.8.7. There were a total of 33 demonstration and re-orientation and exploratory and plant protection trials functioning in the District.

4.8.8. The Junior Liaison Officer was on tour for 151 days visiting 155 estates and contacting over 375 planters. He addressed 11 group gatherings and conducted 72 demonstrations in the planters' fields.

4.8.9. Five applications for loan aids were disposed of and calendar of operations were issued in 7 cases. Twenty-six follow up visits were paid to the loan aided estates.

4.8.10. A quantity of 1068.61 litres of seed coffee was distributed to 256 planters during the 1960-61 season.

4.9. *South Kerala Liaison District:*

4.9.1. Shri P. K. Ramachandran, Junior Liaison Officer, continued to be in charge of the S. Kerala Liaison District till 15th February 1961 when he was transferred to the North Wynaad Liaison District. The Senior Liaison Officer, Coimbatore, assisted by a Liaison Assistant was holding charge after that date.

4.9.2. About 4,500 acres of coffee originally attached to the Pulneys District in the Bodi and Chinnamanur Hills were transferred to the jurisdiction of S. Kerala as these areas were lying contiguous to the coffee tracts of S. Kerala. Consequent on this, the headquarters of this office was shifted from Kottayam to Bodinayakanur which is more centrally situated to the zone.

4.9.3. Blossom showers were scanty and not uniformly received in the District. A crop of nearly 300 tons of Arabica and 525 tons of Robusta is expected for the year 1961-62.

4.9.4. The general standard of coffee culture in the District has been of a low standard which is now slowly gaining momentum towards betterment. It has been a practice to grow coffee mixed with other crops in the backyards. On account of the intensive propaganda and advice rendered on the economics of growing the crop in pure blocks, the present plantings are exclusively for coffee.

4.9.5. Except for the prevalence of shot hole borer in a mild form in most of Robusta holdings, no other pests or diseases were observed extensively.

4.9.6. There were 12 demonstration and 3 re-orientation plots functioning in the District during the year. The Liaison Officer was on tour for 120 days and visited 122 estates contacting over 200 planters. Twenty-six demonstrations were conducted

in the planters' fields and 11 group gatherings of planters were addressed. Six hundred and twenty-one litres of seed coffee was distributed to 162 planters.

4.10. *Koppa Liaison District:*

4.10.1. Shri H. A. Krishna Murthy, Liaison Assistant, continued to be in charge of the District till 11th May 1961. Shri P. G. Sundareswaran, Liaison Assistant at Headquarters, was in charge from 12-5-1961 to 6-6-1961. Shri B. R. Venkatanarasimha Iyengar, Junior Liaison Officer, took over charge of this District from the 7th June 1961.

4.10.2. The District covers an area of about 25,000 acres with almost equal acreages under Arabica and Robusta.

4.10.3. The drought period during 1960-61 extended over a period of 4 months. Blossom showers were received in abundance in the first week of April. An unusually wet weather was experienced during May 1961 with a total precipitation during the month varying from 15 to 20 inches in the different parts of the District. While this helped in producing a profuse flush and good setting of crop in Arabica, caused a poor setting of blossom on the Robusta resulting in a fall of 25 to 35 per cent from the estimate on the blossom. The crop in this District is estimated at 4,000 tons for the year 1961-62.

4.10.4. *Pests and Diseases:* The incidence of pests and diseases was mild and in stray pockets except for the wide-spread and heavy incidence of black rot during July 1961. This is attributed to the heavy and continuous downpour of rain during the month. The rainfall recorded in July 1961 was 75.91 inches as against 45.02 inches in the same month in 1960. Timely control measures were advocated and adopted.

4.10.5. The officers in charge of the District were on tour for 206 days visiting 218 estates, conducting 30 demonstrations in the planters' field and partaking in 20 group gatherings and meetings. Over 100 advisory notes were issued in person and by correspondence. A total quantity of 733.32 litres of seed coffee was distributed to 96 planters.

4.11. *Shevaroys Liaison District:*

4.11.1. Shri C. K. Vasudevan, Junior Liaison Officer, continued to be in charge of the Liaison District. He was on leave from 16th April to 9th May and from 10th June to 15th July 1961 when the District was placed in charge of the Junior Liaison Officers, Coonoor and Manantoddy, respectively.

4.11.2. There has been a considerable variation in the weather during 1960-61 as compared to 1959-60. Summer was felt to be hotter and winter rather severe with many misty hours in the day and night. Rains in December-January hampered crop ripening, harvesting and drying. Months following that were dry and the blossom showers delayed and scanty in many places. The crop for the coming season has been estimated at 2,000 tonnes.

4.11.3. The incidence of pests and diseases was below pest level. Green bug continued to be a major problem on the Shevaroys. In spite of insecticidal sprays, it has

not been kept under satisfactory check in many endemic areas. The only period when the pest was in an apparent state of inactivity was December to April. Stem borer, though noticed throughout has been brought under check by slightly re-orienting the timing of swabbing. Leaf disease was particularly noticed in under-nourished and over-bearing coffee and where protective fungicidal sprays were not effectively carried out. Cercospora was noticed in isolated cases on young coffee in the nursery and newly planted area.

4.11.4. During the year under report, there were in all 10 demonstration and 8 re-orientation plots functioning in the District. The Liaison Officer and his staff paid 70 follow up visits to the loan aided estates. Spot inspections of 5 estates which had applied for grants-in-aid were carried out. A total quantity of 302 litres of seed coffee was issued to 66 planters.

4.11.5. The Liaison Officer was on tour for 242 days visiting 394 estates and contacting over 400 planters. One hundred demonstrations were conducted in the planters' fields, and 12 meetings of planters were addressed.

4.11.6. The tempo of improving the existing stand of coffee and thereby increase the overall production of Arabica coffee in the Shevaroys has gained an impetus. It may be that the efforts of the advisory service over the past few years to increase per acre production by educating all sections of planters on the advantages of organised and scientific working of holdings, have commenced to give rewards. There has been a growing demand for balanced fertilizers and plant protection chemicals. The demonstration and re-orientation plots have been serving their purpose rightly and the visual results observed on these and also in the other progressive farmers' fields are acting a continuous fillip to the planters.

N. G. CHOKKANNA,
Director of Research

Statement showing the Supply of Seed Coffee of Station Selections from 1948-49 to 1960-61

Year	Arabica Station Selections lbs.	Kents Arabica lbs.	Robusta S. 274 lbs.	Robusta lbs.	Excelsa Liberica lbs.	Total lbs.	No. of planters/ Govt. Agencies to whom seed coffee was distributed
1948-49	150	262	62	759	2	1,235	164
1949-50	253	173	47	506	—	979	168
1950-51	400	366	40	1,046	1	1,853	237
1951-52	695	80	45	1,139	—	1,959	228
1952-53	888	45	35	875	9	1,852	310
1953-54	1,456	20	106	720	31	2,333	500
1954-55	5,421	—	77	800	39	6,337	1,247
1955-56	10,669	—	189	1,164	27	12,049	1,693
1956-57	13,397	—	45	296	26	13,764	2,034
1957-58	13,504	—	34	780	14	14,332	2,529
1958-59	7,746	—	136	992	32	8,906	2,205
1959-60	11,444	—	106	358	78	11,986	2,512
1960-61	10,440	—	66	606	17	11,129	2,142
Total	76,463	946	988	10,041	276	88,714	

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Total	76,463	946	988	10,041	276	88,714	

Statement showing the Distribution of Seed Coffee in Liaison Districts during 1956-57 to 1960-61

	Name of the Liaison District	Year 1956-57		Year 1957-58		Year 1958-59		Year 1959-60		Year 1960-61	
		Arabica — lbs.	Robusta lbs.	Arabica — lbs.	Robusta lbs.	Arabica — lbs.	Robusta & Excelsa lbs.	Arabica — lbs.	Robusta & Excelsa lbs.	Arabica — lbs.	Robusta & Excelsa lbs.
1	Chikmagalur	1,721	26	1,043	9	772	3	1,099	8	1,068	2
2	Mudigere	3,143	74	3,355	65	1,068	40	1,496	23	863	27
	Koppa	—	—	—	—	821	64	814	15	935	27
3	Saklaspur	1,623	30	1,406	12	879	33	1,150	18	1,086	5
4	North Coorg	2,346	3	1,350	12	908	22	1,274	8	454	4
5	Mercara	—	—	—	—	—	—	—	—	420	8
6	South Coorg	1,650	2	3,120	102	789	145	1,340	85	1,200	108
7	Kalpetta	1,439	82	722	220	329	330	409	109	518	169
8	Manantoddy	—	—	—	—	—	—	—	—	272	88
9	Coimbatore—Annamalais	462	128	1,906	176	328	56	482	13	309	15
10	Yercaud	428	—	304	2	206	—	333	8	302	—
11	Pulneys	—	—	—	—	944	12	1,520	8	1,068	1
12	Nilgiris	—	—	—	—	433	—	518	10	400	14
13	South Kerala	—	—	—	—	198	455	325	234	405	216
14	To Outside Normal Coffee Zones from C. R. Station	585	22	298	230	71	—	684	3	1,140	5
	Total	13,397	367	13,504	828	7,746	1,160	11,444	542	10,440	689

Statement showing the Distribution of Seeds of Improved Strains of Arabica Coffee from the Research Department of the Coffee Board according to Zones/States from 1943 to 1961

Sl. No.	Zones/States	S. 795		S. 288		S. 335		S. 645		Others		Total	
		lbs.	kg.	lbs.	kg	lbs.	kg.	lbs.	kg.	lbs.	kg.	lbs.	kg.
Madras State:													
1	Shevaroys	1,512	686	379	172	33	15	16	7	102	466	2,042	926
2	Pulneys	3,140	1,424	1,220	553	42	19	10	5	15	7	4,427	2,008
3	Coimbatore and Nilgiris	3,999	1,814	622	282	131	59	79	36	85	39	4,916	2,230
	Total	8,651	3,924	2,221	1,007	206	93	105	48	202	92	11,385	5,164
Mysore State:													
1	Chikmagalur	6,827	3,097	1,816	824	697	316	89	40	277	126	9,706	4,403
2	Mudigere	8,592	3,897	4,027	1,827	1,189	539	27	12	249	113	14,084	6,388
3	Koppa	2,345	1,064	201	91	14	6	—	—	10	5	2,570	1,166
4	Saklaspur	5,165	2,343	2,700	1,225	537	244	26	12	631	286	9,059	4,110
5	N. Coorg	8,128	3,687	1,109	503	301	137	34	15	231	105	9,803	4,447
6	S. Coorg	9,936	4,507	946	429	53	24	161	73	164	74	11,260	5,107
	Total	40,993	18,595	10,799	4,899	2,791	1,266	337	152	1,562	709	56,482	25,621
Kerala State:													
1	Wynaad (Kalpetta & Manantoddy)	4,374	1,984	455	206	115	52	18	8	71	32	5,033	2,282
2	S. Kerala	914	415	10	5	4	2	—	—	—	—	928	422
	Total	5,288	2,399	465	211	119	54	18	8	71	32	5,961	2,704

Sl. No.	Zones/States	S. 795		S. 288		S. 335		S. 645		Others		Total	
		lbs.	kg.	lbs.	kg.	lbs.	kg.	lbs.	kg.	lbs.	kg.	lbs.	kg.
	Andhra State	852	386	81	37	23	10	—	—	—	—	956	433
	Assam State	1,180	535	358	162	111	50	—	—	1	1	1,650	748
	Bombay State	3	1	7	3	—	—	—	—	—	—	10	4
	West Bengal	273	124	44	20	12	5	—	—	—	—	329	149
	Madhya Pradesh	1	1	14	6	8	4	—	—	—	—	23	11
	North East Frontier Province	6	3	8	4	—	—	—	—	—	—	14	7
	Manipur	10	5	12	5	—	—	—	—	3	1	25	11
	Orissa	61	28	25	11	—	—	—	—	—	—	86	39
	Andaman Administration	19	9	9	4	9	4	9	4	—	—	46	21
	Sikkim	—	—	2	1	—	—	—	—	—	—	2	1
	Others	22	10	11	5	11	5	—	—	—	—	44	20
	Grand Total	57,359	26,020	14,056	6,375	3,290	1,491	469	212	1,839	835	77,013	34,933

In addition to the above, 11,156 lbs. (5,060 kg.) of seeds of Robusta Selections have been supplied to growers from the Department during the period 1943 to 1961.

Note:—One lb. of seed coffee of Arabica and half a pound of Robusta is considered sufficient for raising seedlings to plant one acre.

Demonstration and other Trial Plots laid out in Private Estates under the Accelerated Programme of Demonstration of Improved Techniques of Coffee Cultivation as at the end of July 1961

Sl. No.	Name of the Liaison Zone	Demonstration Blocks	Re-orientation Plots	Manurial Trials	Varietal Trial Plots	Plant Protection and Other Trials	Loan Aided Estates
1	Chikmagalur	12	2	5	—	4	36
2	Mudigere	11	7	5	7	—	45
3	Koppa	9	9	7	—	3	1
4	Saklaspur	10	2	11	—	7	50
5	Hassan	1	—	2	—	1	3
6	Mercara	8	—	—	—	—	18
7	N. Coorg	7	—	5	—	—	18
8	S. Coorg	19	5	2	5	—	34
9	Kalpetta	10	2	8	—	3	62
10	Manantoddy	12	1	1	—	—	5
11	Coimbatore	—	7	—	—	—	—
12	Nilgiris	12	8	4	—	2	4
13	Pulneys	16	5	9	1	2	7
14	Yercaud	10	8	—	—	—	7
15	S. Kerala	12	3	—	—	—	—
	Total	149	59	59	13	22	290

ERRATA — PART V

Page	*Para*	*Line*	*Printed as*	*Read as*
33	5.3.6	3	Supply pulping	Supply of pulping
34	7.3	18	New malady on Die-back complex	New malady or Die-back complex
36	1.6	5	brickly	bricky
36	1.9	3	Sun dry	sundry
39	2.18	6	a	on
41	4.2	20 & 21	However it was found..... populations	please delete
44	5.10	4	Bordeaux on	Bordeaux or
50	17.2.1	19	H_2	H_3
51	18.3	1	sowing	storing
59	D	1	48 estates	45 estates
74	2.1.6	2	Badaca	Babaca
–	-	3	Euiamba	Eviamba
75	2.2.1	2	Gene Bank	gene bank
76	3.2.1.2	4	lisease	disease
77	3.2.6	2	S.178	S.583
–	–	4	B.A.25	B.A.21
–	3.2.7	1	S.178	S.583
–	3.2.9	2	Var.	Var.
–	–	3	S.483	S.583
78	3.2.10.1.2.4	1	S.178	S.583
80	6.3.1	4	feature	features
81		5	0	O +
–		6	†	delete
–		–	o	O
98	2.5.3.4	5	(60: 45: 60)	(60: 0: 60)
99	4.1.1	3	Fourteenth	Thirteenth
102	6.3.5	7	N_2P_2	N_2K_2
103	–	3	Photoeter	Photometer
103	–	4	Pschyrometer	Psychrometer
109	–	5	7	7′
112	–	8	Preblossom 20 lb	Preblossom 30 lb
114	–	6	Planted	Spacing
115	–	1	Phosphates	Phosphate
115	–	16	lb	1 lb.
118	–	7	Planted 13′×13′	Spacing 13′×13′
148 (3.7)	7 (Penultimate)	3 to 5	*Months* were significant..... predators. In this regard ..... parasites. Also,.....same period.	*Months* were significant for parasites and predators where October '60 showed maximum populations.
149 (3.7)	1	1(i)	The peak level..... December-May	The peak level..... October-February

Page	*Para*	*Line*	*Printed as*	*Read as*
154	4.2.3	4	.....instars, the first instar .....4 days (range 3–4);	.....instars, the first instar .....3.4 days (range 3–4) ;
155	4.3.6	1	Movements of the larvae was...	Movements of the larvae were...
155	4.3.7	3	The larval stage ranged from 92–143 days.....	The larval stage ranged from 96–147 days.....
158	7.2	2	Field evidences.....this specie.....	Field evidences.....this species.....

Page	*Table*	*Col.*	*Printed as*	*Read as*
164	V	2	(C D I) B A H G J K	(C D I) B A H G J K
165	VI	5	I C D B A H J G K	I C D B A H J G K
	VI	8	(C I) D A B H J G K	(C I) D A B H J G K
	VI	9	(B C D I) A H J G K	(B C D I) A H J G K
166	VII	4	7 1 2 8 3 4 9 5 6	7 1 2 8 3 4 9 5 6
167	VIII	2	(1 2 4 5 6) 3 7 8 9	(1 2 4 5 6) 3 7 8 9
169	X		A. MORSTATTI	X. MORSTATTI
171	XII		$A_{(h)}B_{(h)}A_{(l)}E_{(h)}H_{(l)}C_{(h)}H_{(h)}C_{(l)}B_{(l)}$	$A_{(h)}B_{(h)}A_{(l)}E_{(h)}H_{(l)}C_{(h)}H_{(h)}C_{(l)}B_{(l)}$
173	XIV	3	A F C E H B I D G J K L	A F C E H B I D G J K L
	XIV	4	F E B A C H I D G J K L	F E B A C H I D G J K L
	XIV	5	J F E C B A H I D G K L	J F E C B A H I D G K L
	XIV	6	A I C B F E J H D G K L	A I C B F E J H D G K L
	XIV	7	A I B C F E H J D G K L	A I B C F E H J D G K L
	XIV	8	A I B E F C H J D G K L	A I B E F C H J D G K L
175	XV(a)	Conclusion	Depths 0–12″ 12–24″	0–12″ 12–24″
			Months: April 1959, Feb. 1959, Jan. 1960, Nov. 1959, Dec. 1958.	April '59 Feb. '59 Jan. '60 Nov. '59 Dec. '58.
178	XVI(a) (continued)	-do-	Months: March 1961, March '60. May 1960, Jan. 1961, Oct. 1960.	Mar. '61 Mar. '60 May '60 Jan. '61 Oct. '60
179	XVI(b) (continued)	-do-	Months: March 1960, May 1960, Mar. 1961, Jan. 1961, Oct. 1960.	Mar. '60 May '60 Mar. '61 Jan. '61 Oct. '60
187	XXIII	(18.)4	—	Yes

Page	*Line*	*Against*	*Read*
190	33	Bordeaux and Flit-407 as well as Flit 407 also—3 and 4 rounds spray have given....	Bordeaux and Flit-407 as well as Flit 407 alone—3 and 4 rounds spray—have given....
197	Table for trial 2	B_1 Colloidal copper—11 lb. in 40 glns. water.	B_1 Colloidal copper—1 lb. in 40 glns. water.
		B_2 – do –	B_2 –do–
200	18	Microorganism	Micro organisms
200	31	1% Flit–406–do	1% Bordeaux at monthly intervals
200	32	0.4% Bordeaux	0.4% Flit-406 –do–
201	11	bbasket	basket
201	24	After the sentence ending with – 'were noticed' add the following :— "The percentage of success of grafts even where healthy stock and healthy scion were used was more or less of the same degree as when diseased stock or scion was used."	
205	19	treatment	treatments
231	Table XVI	Against the months of Feb., March. etc..	read Feb. 1961, March 1961, etc.